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THE UNIVERSITY OF ALBERTA

A BIOECONOMIC ANALYSIS OF THE POTENTIAL FOR GAME RANCHING IN NORTHERN ALBERTA

by

© LLEWELLYN C. MATTHEWS

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled A BIOECONOMIC ANALYSIS OF THE POTENTIAL FOR GAME RANCHING IN NORTHERN ALBERTA submitted by LLEWELLYN C. MATTHEWS in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in AGRICULTURAL ECONOMICS.

..William E. Phillips..

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....

Date..28 March 1988..........

ABSTRACT

Game ranching has been proposed as an agricultural activity for northern Alberta. This study, through modeling a case study, examined the economic viability of commercial game ranching in northern Alberta. Linear programming was used to optimize the ranch production strategy. A systems model then simulated the ranch operation and cash flows from establishment to maturity. The cash flow variability was obtained by a Monte Carlo simulation. The resulting coefficient of variation (CV) was used in the Capital Asset Pricing Model to obtain the required rate of return. The cash flows were discounted by the required rate of return to obtain the net present value (NPV) of the case game ranch.

The production of three possible species is considered, moose (*Alces alces*), wapiti (*Cervus elaphus*) and bison (*Bison bison*). The optimal production strategy is to produce wapiti as the major species, and moose as a secondary species. As much land as possible should be cleared to increase the grazing available to wapiti, and the wapiti should be fed in winter. The product prices affected the products (live sales, venison sales and velvet sales) produced which in turn determined the wapiti herd structure. Under present prices, the main female wapiti product is three-year old breeding stock (maximum age permitted), with males sold as calves. Moose (male and female) are harvested at one year of age.

Female wapiti live prices must drop to near slaughter value for the production strategy to change. When live and velvet prices have fallen, then velvet and venison are the main products. Males and females are slaughtered at two years of age to allow velveting and one crop of calves. If velvet prices do not fall below $108/kg, then the optimal production strategy is to produce velvet as the main product, having a male oriented herd structure.

The initial investment with a population of 200 wapiti and six moose, is $1,700,153. The CV of cash flows discounting by the risk free interest rate is 0.4446 which results in a required rate of return of 10.3%. The NPV of the game ranch, assuming female prices rise for 15% per year for the first five years and then decrease 10% per year until slaughter value is reached (velvet and male prices also decrease after five years), is $467,873. The break-even year is year 15 and the internal rate of return is approximately 12% (real). The NPV is very sensitive to the timing and rate of increase for female wapiti prices. A negative NPV results if female prices do not increase at all, or start to decrease before three years. The NPV is also sensitive to the intitial herd size with a negative NPV for an initial herd of 100 wapiti.

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I can say I'm pleased to see this thesis over and proud to put my name to it, but it would be wrong to claim all the credit. I may have done the writing, but it could not have been accomplished without the assistance of friends, colleagues, professors and family. I would like to take time to thank them.

First of all I would like to thank Donald Lindsay. This thesis is in many ways a product of my experience in Africa. It was through his invitation and generosity that I was able to travel through southern Africa. It was that experience that spawned my interest in game ranching.

There are the many people in the University community to be thanked. My supervisor, Dr. Bill Phillips and Dr.Bob Hudson provided a sounding board for my ideas, set me straight, and watched me grow from an idealistic biologist to a point today, where I hopefully take a more balanced view of things. I would particularily like to thank Lyle Renecker who provided much of the data I used. I thank the students and staff of Rural Economy for the many discussions that are so much a part of the learning process. The support staff of Reg, Barb, Hildegard, Jim, Wendy and Holly were also essential in making this thesis a reality.

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I. INTRODUCTION

The economy of northern Alberta is currently narrowly based on a few resource industries. Expansion of the agricultural land base is seen as a means of assisting the development of northern Alberta (Northern Alberta Development Council, 1983). Diversification of the economic base is a means of preventing local economic difficulty should one economic sector suffer a decline. However any new activity must be economically efficient to insure long term viability. The economic rent attributable to a new activity must be greater than the economic rent of the activity it replaces. In this light, the potential for game ranching merits investigation.

The northern fringe of agriculture is the extensive margin of agricultural land use where economic rent to land under the best management is zero. Marginal land may become submarginal with rising costs and/or declining product prices. Most of northern Alberta is submarginal for traditional agricultural activities. It is characterized by poor soils [Canadian Land Inventory Class 4 or higher] and a frost free period of less than 75 days (Thompson 1981). Hence, it is unsuitable for sustained cultivation with the exception of forage crops. One exception is the Peace River Region where CLI Class 2 and 3 lands exist with a frost free period of between 75 and 90 days. Nevertheless, most farmers in this area have off-farm jobs to maintain an acceptable income level (Kelly and Moreau 1982, Thompson 1981).

Much of northern Alberta is classified as Boreal Mixedwood Forest, with areas of Boreal Foothills primarily in the Peace Region (Strong and Leggat 1981). The dominant tree cover is aspen (*Populus tremuloides*) with balsam poplar (*P. balsamifera*), white spruce (*Picea glauca*), black spruce (*P. mariana*), and jack pine (*Pinus banksiana*) commonly found. Currently, forestry activity is concentrated on coniferous stands (MacDonald 1983), although aspen is becoming increasingly important for use in oriented strand-board production. In the Peace Region (FMU P4 and P5) for example, only 27% of the area is considered productive coniferous land (Phillips, Armstrong, Beck, and Banskota 1987). Phillips et al (1987) using a discount rate of 5%, estimated an economic rent of $388/ha for productive coniferous land to forestry.

The northern Albertan economy is based largely on the petroleum and forest industries with areas of marginal agriculture. Much of the non-coniferous forested land is not being used productively. It has been suggested by some (Telfer and Scotter 1975, Lynch 1978, Hudson 1980) that game ranching be considered as an alternative form of land use development for this area. The aim of this thesis is to look at the economic viability of game ranching for this area.

Game ranching is the raising of wildlife species as opposed to domestic species, for economic gain. There are two different basic strategies. The first one, often called game farming, involves intensive management of semi-domesticated animals on a small land base with the primary products being meat and breeding stock. The second strategy, often called game ranching, involves maintainance of the animals in an essentially wild state on a large land base minimizing management costs. The primary products are hunting and tourism with secondary products being meat and live sales. The strategy adopted depends on the relative prices of inputs (such as land, fencing, breeding stock, labor, and feed) and products as well as the institutional setting.

Game ranching has a long history, of which domestic animals are one result. Western world interest was renewed in Africa in the early 1960's where ecologists observed vast herds of game living in balance with the habitat. Nearby cattle ranches were experiencing severe habitat destruction. Their hypothesis was that indigenous animals through evolution are much better adapted to the habitat than domestic animals. Consequently a higher biomass should be possible with the indigenous species (Dasmann 1964). The mixed species communities showed methods of reducing interspecific competition resulted in a more complete resource utilization.

This concept was carried to Alberta where it was argued that native ungulates such as bison (*Bison bison*), wapiti (*Cervus elaphus*), and moose (*Alces alces*) are better suited to the cold climate than cattle (Christoperson and Hudson 1978) and could utilize native forage year round (Telfer et al 1975, Christopherson et al 1978), thus eliminating the need for costly land clearing and winter feeding. Telfer and Scotter (1975) showed that Elk Island National Park supported 45% more grazing of wild herbivores than the adjacent Blackfoot grazing lease did of cattle.

Extensive game ranching today is found primarily in southern Africa. Although meat production was the primary reason most ranches started in the 1960's, almost all of the ranches have switched to trophy hunting and tourism as a primary product, with meat as a secondary product from surplus animals. Annual mean profit on a Rhodesian game ranch nearly tripled from $4,556 (Rh) to $12,339 (Rh) over a five year period when the ranch switched from meat production to trophy hunting (Johnstone 1974). Game ranching, involving largely exotic species occurs in parts of the United States. A notable example of a native species game ranch managed for hunting is the Oglala Sioux Reservation in South Dakota (Cole 1974).

Bison ranching also occurs in many parts of the United States with the largest ranch having close to 3,000 head on 22,792 ha (Jennings and Hebbring 1983). Bison ranching however, has developed as a meat and breeding stock enterprise with hunting as a secondary activity. Most bison ranches practice some management such as rotational grazing and yearly round ups. This form is in contrast to the African game ranches that practice minimal animal management (mainly population control) with essentially wild animals contained by game fences. Game cropping for meat in Africa is done by shooting the animals in the field at night and then processing them at an onsite abattoir.

Intensive game farming is also practiced in many parts of the world involving mainly different deer species. New Zealand provides the leading example of deer farming. Deer farming was legalized there in 1970, and by 1983 there were 195,650 deer on farms (Sandry and Zwart 1986). Deer farming started there when sheep and cattle producers were experiencing depressed prices. At the same time venison prices from wild deer shot commercially were very high at $2.20 - $2.67/kg (Anderson 1978). In 1976 - 77, producers started selling velvet (the antler in the growing stage before ossification) which proved to be very lucrative. The deer in New Zealand have been semidomesticated so they are easily handled. They are intensively managed in paddocks and routinely run through yards for velveting, drenching, weaning, sorting and other procedures. Deer farming started on marginal lands, but soon moved to prime lands as better net returns were realized.

Game ranching[1] in Alberta is biologically and technically possible. Elk Island National Park near Edmonton is the closest example to an extensive game ranch in Canada, as it is fenced and managed for wildlife, though not profit maximizing. It produces regular surpluses of wapiti, bison, and moose. There are a few operating deer farms in Alberta and Saskatchewan. Work has been done on wildlife productivity by the Department of Animal Science, University of Alberta. Topics such as bison forage digestibility (Richmond, Hudson and Christopherson 1976), cold tolerance (Christopherson et al 1978) and moose foraging rates (Renecker and Hudson 1985) have been studied.

---

[1] Game ranching from here on will refer to both intensive and extensive operations.

To date however, little work has been done on the economics of game ranching in Canada. Elsewhere, a rough comparison of net returns from the Oglala Sioux game ranch (managed for trophy hunting only) are comparable to returns from cattle; $17,667/yr for cattle and $17,500/yr for game (Cole 1974). These figures do not consider initial investment costs, primarily game fence costs. Budgets for the establishment costs have been prepared for projects in Alberta (Lynch 1978) and Manitoba (P.M. Associates 1984). Profit projections based on projected quasi-income statements have been completed for a hypothetical game ranch in Saskatchewan (Hudson 1982). The study looks at both intensive and extensive game ranches. It suggests all costs excluding land and initial stock costs, could be covered in ten years from both types of ranch. However, the economic analysis is superficial with assumed constant prices. In addition, the production strategies are assumed a priori without an optimization procedure.

If game ranching is to be given serious consideration by private industry, government, and the financial community, then an efficient production plan with a meaningful capital budget analysis is required. This analysis will allow the potential game rancher/investor a view of initial capital investment, operating costs, returns, and the risks that are involved. He will be able to see the financial situation from development to maturity allowing an economic decision on whether game ranching is viable.

There are several objectives to be achieved in this study:

1. To review and assess current information on the biology and management of game ranches including an assesment of the present institutional framework in Canada;
2. To identify the costs, returns, and risks involved in establishing and operating a game ranch;
3. To develop an efficient production strategy based on a case study;
4. To carry out an investment analysis through simulation of the case ranch from establishment to maturity;
5. To assess the sensitivity of game ranching to various economic conditions.

The production and development plan will be based on a case ranch. The Kikino Wildlife Ranch will be used to provide the physical parameters. The Kikino ranch was established in 1979 by the Kikino Metis Settlement, located 39 km south of Lac La Biche, Alberta. The corrals and perimeter fence were constructed in 1980, with the first animals arriving in Feburary 1981. An area of 2,200 ha is enclosed. In April 1985, the ranch contained 68 bison, 33 wapiti and 3 moose. The ranching operations to date have been funded by various Canada Employment projects and settlement funds, with some animals being donated by Parks Canada. The management is planned by a five member board of directors with advice from an advisory committee with representatives from Alberta Fish and Wildlife Division, Alberta Agriculture, University of Alberta, Regional Economic Development Council, and S. Biewald (marketing consultant).

This thesis is organized in the following manner. The second chapter is a review of the background for game ranching in Alberta including the biology, management strategies, and the institutional setting. The third chapter contains the theory and methods of economic analysis and decision making. The parameter values used are presented in the fourth chapter and the models developed. In the fifth chapter the results are presented and discussed. The sixth chapter summarizes the procedures used, conclusions, and ends with implications and recommendations.

II. BIOLOGICAL AND INSTITUTIONAL BACKGROUND

The basis to production economics is the production function. The production function is the relationship between the inputs of environment and management, and the output of animals (products). The relationships among feed, growth, and reproduction must be known before optimal species mix, sex ratio, age structure, and harvest regime can be determined. A poor understanding of these relationships results in mismanagement and unrealistic economic projections.

The biological relationships for game animals are not well defined compared with the wealth of knowledge on domestic animals. Most literature is derived from studies on wild populations where influences not found on game ranches exist. Some information is inferred from other subspecies or related species. The biology of three species selected as the most likely for game ranching in northern Alberta (bison, wapiti and moose) is reviewed in this chapter. The characteristics such as feeding habits and requirements, reproduction, social structure, diseases and life history are reviewed as they relate to game ranching. The model development chapter contains the parameter values used in the models.

The institutional setting is also reviewed in this chapter. The institutional setting consists of legislative controls and social norms. The legislation sets restrictions on what products may be produced and on different aspects of ranch operations. Social norms influence the type of products that are demanded by society. Social norms can also give an indication of future directions that game ranching could take to meet social objectives.

A. Bison

Bison are well suited to game ranching in northern Alberta and offer some advantages over traditional livestock. Bison are extremly adaptable to a variety of weather conditions as evidenced by their existence from the Northwest Territorities to Florida. They have great adaptability to withstand extreme cold weather with a lower critical temperature of less than -30°C compared to -14°C for Herefords (Christopherson et al 1978). In fact, their lowest metabolic rate was at -30°C. Winter foraging is accomplished by swinging their head from side to side to clear the snow (Welch 1982). A snow depth of several feet does not seem to bother them (Meagher 1978) and selection of catering sites is suggested to be determined by forage quality or quantity (Welch 1982). Bison are less selective than cattle in their selection of forage (Meagher 1978) with a higher digestibility of poor quality forage such as sedge meadow hay or brome grass-fescue hay (Christopherson et al 1978).

Life History

The bison rut peaks during the period 21 July to mid August with a secondary rut from 25 August to 3 September (Haugen 1974). Haugen (1974) suggests that the secondary rut may be a second estrus for cows not impregnated in the first rut. During the rut bulls form temporary pairs with cows called "tending bonds" (Meagher 1978) and breed several cows sequentially. There is a gestation period of 285 days (Haugen 1974) with the main calf drop in May (60% of the calves dropped between the 7th and 21st of May). Cows continue to grow for six or seven years while bulls grow until nine or ten years (Jennings and Hebbring 1983). Old age starts between 12 and 15 years of age (Meagher 1978) with a life span of 20-25 years reported in some zoo animals (Jennings and Hebbring 1983).

Bison cows normally produce their first calf in their third year and are capable of producing one every year thereafter (Halloran 1968, Haugen 1974). However, Halloran (1968) reports 13.3% of two year olds calved, but only one third of those calving also produced a calf as three year olds. Extensively raised animals may breed later. Meagher (1978) reports cows reach sexual maturity at four years of age in Yellowstone National Park. The rate at which three year old and older cows produce calves seems to be a function of management.

Range conditions are one factor that can affect the calf crop. Custer State Park reported a calf crop varying between 60% and 80% when they felt the range was overstocked, a herd reduction was carried out and the calf crop averaged 90%-92% (Jennings and Hebbring 1983). Summer drought can also affect the number of cows coming into estrus. Jennings and Hebbring (1983) report the fall weaning of calves raised the calf crop from 50% to 85%-90% as the cows were in better condition during pregnancy.

Most of the breeding in free ranging populations is done by fully mature bulls seven to eight years old (Meagher 1983). Haugen (1974), however, found that three of six yearling bulls and most older bulls were capable of breeding. Social structure, therefore, determines to a large extent which bulls do the breeding. Yearling bulls are unlikely to breed as they are not dominant to two-year old cows. Running both two year-old bulls and cows together separate from the main herd increases the two year-old calving rate from 90% to 95% (Jennings and Hebbring 1983). Three year old and older bulls do the best breeding and Jennings and Hebbring (1983) suggest a bull age structure of 40% three year olds, 30% four year olds, 20% five year olds, and 10% six year olds. They suggest a sex ratio of 1♂:10♀ except for small herds where a ratio of 2♂:10♀ or 2♂:15♀ is recommended.

Bison are primarily herd animals. The main herd consists of cows and young bulls up to two or three years of age (Meagher 1978). One or two older herd bulls are often seen with the herd. The base herd numbers from 11 to 20

(Fuller in Meagher 1978), which group periodically with other base herds to form larger herds. The bulls over two or three years old form smaller bachelor herds and mature bulls are often solitary.

Nutrition

Bison are almost exclusively grazers. They are less selective than cattle and prefer warm season grasses (Meagher 1978). Prefered grasses (Jennings and Hebbring 1983) are wheat grass (*Agropgron* spp.), bluegrass (*Poa* spp.) and smaller fescues (*Festuca* spp.). However, an exception to the summer grazing was found in Alaska (Waggoner and Hinkes 1986) where shrubs made up 94% of the summer diet, primarily willow (*Salix spp.*). The browsing is thought mainly due to a lack of available grazing. In winter in the boreal mixedwood forest, sedges (*Carex* spp.) make up the main portion of the diet with 78% of the craters in sedge meadows (Welch 1982). Diet analysis showed that *Carex* spp. made up 82% and grass 17% of the bison winter diet (Telfer and Cairns 1979).

Christopherson and Hudson (1978) found bison had a higher digestibility of dry matter, nitrogen and fiber components than cattle for coarse sedge meadow hay and poor quality brome grass-fescue hay, but it was similar for high quality alfalfa hay and medium quality alfalfa-brome hay. They found that the voluntary intake per unit body weight was similar to cattle. Feedlot experience shows bison consuming 2.25% of body weight (Jennings and Hebbring 1983).

Despite the higher digestibilty displayed by bison, they have a lower feed efficiency and rate of gain than cattle (Christopherson et al 1978). Average daily gains in a feedlot were 0.41-0.63 kg for bulls and 0.23-0.50 kg for cows compared to cattle (Hereford) displaying 0.95-1.2 kg for bulls and 0.77-1.1 kg for cows (Peters 1958).

Health

Bison on the whole, are relatively healthy animals that require little health care. Problems usually arise when large numbers are confined in small areas with no pasture rotation. Health problems can be divided into two major areas, diseases and parasites.

There are two major diseases that ranchers need to be aware of in bison, clostridial infections and brucellosis. There are several species of *Clostridium* that occur in bison causing over eating disease, blackleg and lockjaw. Deaths diagnosed as bloat are most often a result of *Clostridium*. Ranchers in the United States normally vaccinate their bison with "7 Way" for *Clostridium* (Jennings and Hebbring 1983).

Brucellosis caused by *Brucella abortus* is the other common disease in bison. It causes abortion in the later stages of pregnancy and is passed on by ingestion or licking of contaminated food or material. There is a controversy over whether bison pass it to cattle (Jennings and Hebbring 1983). Brucellosis is not a current problem in Alberta except for Wood Buffalo National Park. Bison are susceptible to two other fatal diseases, tuberculosis and anthrax. These are not current problems but any animal found with them must be destroyed.

Bison are host to a large number of internal parasites of the phylums *Nematoda*, *Cestoda* and *Platyhelminthes*. Most of these infect bison by being ingested with forage. Parasites only become problems in large numbers that occur with high stocking rates and no rotational grazing. Various methods of worming are described in Jennings and Hebbring (1983).

Management

Jennings and Hebbring (1983) contains a comprehensive review of various bison management techniques. Some of the major considerations important to an Albertan game ranch are outlined below.

A system should be in place so that each animal can be handled at least once a year. This allows the animals to be sorted for culling, sale and separation purposes. It also facilitates functions such as weighing, vaccinating, tagging and pregnancy testing. For this to occur, there must be a system to round up the animals, a corral system to hold them, and a squeeze and sort system. If winter feeding is a regular activity, the animals will become habituated to coming to the feeding site each winter. Older bulls (over five years old) are often hard to round up or bait and can cause trouble when handling; it is usually better not to round them up.

Corrals should be sturdy and chutes should have tops to prevent the animals from jumping out. Sharp turns should also be avoided in lanes, as should square pens. Chutes should have smooth sides to prevent horns from catching. Patience should be used in handling. Animals pushed too hard can lead to injuries from goring and tramping. Subadults are the most susceptible to injuries from older males (Hudson and Tennesen 1978). Some ranches dehorn cows to minimize injuries during handling.

Another large area of management is supplemental feeding and weaning of calves. Unless the land base is large and contains a good number of sedge meadows, supplemental feeding in winter will be necessary. Animals should be excluded from pasture containing winter feeding areas (sedge meadows) during the summer. Supplemental feed should be wild hay or poor quality alfalfa. Range cakes can also be added to supplement hay. It has been reported that feeding a high protein supplement just before calving produces healthier calves.

Weaning of calves is advantageous where possible. As previously stated, the weaning of calves in the fall has been associated with an increased the calving rate. Including grain when weaning also has the advantage of preconditioning the calves which is important if they will eventually end up in a feedlot. Cows should be kept well away from the calves when weaning.

B. Wapiti

The wapiti is well suited to game ranching in northern Alberta. Like bison, wapiti are a gregarious animal making herding and management easier. Their natural food habits change with the seasons to match the types of food available. They require little intensive management except during the calving and rut periods. They have a proven ability to become semi-domesticated and are easily handled as deer farms in New Zealand have shown.

Life History

Wapiti calves are born in early June after a gestation period of 247-262 days (Bubenik 1982). Calf survival is related to birth weight. Calves weighing more than 16 kg at birth have a 90% chance of surviving to four weeks while calves weighing less than 11.4 kg have a less than 50% chance of surviving (Bubenik 1982). In New Zealand, red deer calf deaths have been greatly reduced by intensive management. Mortality rates as low as two out of 93 births and four out of 75 births have been reported (Spiers 1985). Normally only one calf is dropped with twins a rare occurance. The only major predator of calves is the black bear while calves are less than one month old (Schlegel in Taber, Raedekel and McCaughran 1982). Cows separate from the main cow herd to calf in areas which provide cover and water. After two or three weeks they rejoin the herd when the calf is able to travel. The cow herds also contain young bulls. The mature bulls are solitary or in groups of five or six during the summer.

The rut starts in the beginning of September and can last until the end of October, though rutting activities can begin in mid August. The peak rutting period in Alberta has been placed between the 8th and 12th of September (Struhsaker in, Boyd 1978). During this period the mature bulls collect harems, usually 15-20 cows and drive off all other bulls. The younger bulls may stay on the fringe of the harems, mating if the opportunity arises. After the rut, the bulls leave the cow herds. During the winter in situations where the wapiti are fed, large all sex herds will form such as at the National Elk Refuge where 15,000 elk have been recorded.

Cows may become sexually mature as yearlings with reported pregnancy rates between 0 and 80% (Bubenik 1982), correlated to body weight. Pregnancy rates of adult red deer (greater than 3 years old) of 96% and 100% are possible under intensive management. The cow's estrus period lasts less than 18 hours, but three or four estrus periods are possible with an average of 21 days between them (Bubenik 1982). Bulls are capable of mating as yearlings, but do not normally become sexually mature for social reasons until three or four years old. Yearling or two year-old bulls may not even take part in rutting activities. However, if no mature bulls are present yearlings can mate all cows (Squibb 1985). The ideal sex ratio required to ensure that all cows are served is unclear. In wild populations most mating is done by a few prime bulls, sex ratios varied from 6♂:100♀ to 25♂:100♀ (Mohler and Toweill 1982). On intensively managed farms in New Zealand, sex ratios of one bull to 40 cows are used with single sire mating and a back up bull introduced after two estrus cycles (Spires 1985). R. Alsager (private rancher, pers comm) in Saskatchewan has run as many as 70 cows with one bull.

Nutrition

Wapiti consume a wide variety of plants that vary according to season and availability. In studies in the boreal/mixedwood forest, summer diet was 95% herbage and 5% browse, changing to 36% - 60% herbage and 35% - 64% browse in the winter (Telfer and Cairns 1979). Sedges were the most important component making up 23% of the winter diet and 71% of the summer diet. Grasses made up 22% of the summer diet and 13% of the winter diet. Willow was the primary browse composing 44% of the winter diet, with aspen and Saskatoon serviceberry (*Amelanchier alnifolia*) making up an other 18%. The diet follows the plant phenological stage, selecting those available plant parts giving the highest nutritional quality. Wapiti are, therefore, very generalistic feeders and will switch their diet composition as plant availability and nutrition change.

Protein deficiences are likely in winter when poor quality forage such as browse and dried grass make up a significant percentage of the diet. When the diet contains a high percentage of fiber, the intake drops. Nelson and Leege (1982) recommended that forage have a minimum 5.5 - 6% crude protein.

Supplemental feeding of wapiti in winter is useful to ensure that they do not loose excessive weight. It is natural for wapiti to lose weight during the winter through mobilization of fat reserves. They undergo a period of rapid catch-up growth during the spring. The spring catch-up growth however, can not completely compensate for winter feeding. In one experiment yearlings that were not fed during the winter, were on average 38 kg lighter the next fall than ones that were winter fed (Watkins and Hudson 1984).

Excessive winter weight loss can have adverse effects on reproductive success in the cows. In one study (Thorne et al in Nelson and Leege 1982) it was found that pregnant cows who lost more than 2.6% of body weight over the winter, produced calves weighing less than the 16 kg needed for the 90% survival rate to one month. However, work at the University of Alberta suggests that, with spring catch up growth, female fall condition is probably more important for calf birth weight (R. Hudson, pers comm). *Ad lib* winter feeding of good quality forage will result in continuous weight gain (Watkins et al 1984) to a maximum gain of 0.3 kg/day, but there is evidence that over weight can cause calving problems (Henry Kozak, U of Alta, pers comm).

Nelson et al (1982) indicate that calves consuming 23 - 31 gm/kg/day BW of meadow hay will not lose weight. Pregnant cows require 17.5 - 19.4 gm/kg/day BW of hay and concentrate, to maintain or slightly gain weight. Consumption will decrease when concentrates are fed. Yearlings in ad lib feeding trials would consume an average of 26 gm/kg/day BW of alfalfa and protein supplement. If the diet is to be supplemented with grain, experience with red deer (Milligan 1984) shows that it should be introduced slowly at 0.1/kg/hd/day and should not exceed 1.5 kg/day. On the National Elk Refuge winter feeding was found to be most effective using alfalfa pellets at a rate of 3.6 kg/day as it minimized waste (Robbins and Wilbrecht 1979). At the maximum level, adequate rougage should also be fed to minimize risk of acidosis.

Antler Development

Wapiti males may warrant consideration for their antler production both as velvet and as trophies. Antler size can not be directly related to age, but to nutritional status and social status of the herd. Antlers are usually first developed in yearlings when spikes develop about 40 cm long. The best antlers can be expected at about age 11 after which they start to decline (Bubenik 1982). However, in a study of Alberta wapiti, Flook (1970) found maximum antler weight reached at 7 years. Preliminary data from farmed wapiti shows a maximum velvet yield at 10 years[2].

Calcium and phosphorus are the two most important minerals for antler growth. They are obtained both from diet and skeletal breakdown. During the first half of antler development, the estimated daily intake is 72 gm of Ca and 32 gm of P (Bubenik 1982). For maximum development these levels can probably be increased. Velvet collection is done before the cartilage starts to mineralize, usually in June. Renecker and MacLean (1987) describe the velveting procedure.

Health

Like most wildlife species, wapiti are relatively free of health problems compared to domestic livestock and they possess a highly developed immune system. Problems usually occur when they are concentrated in small areas such as could occur on intensive game farms.

Transmission of gastrointestional parasites, both cestodes and nemetodes, is through ingestion of larvae from the pasture and can build up to high levels when the animals are concentrated in one place for a significant length of time. While high numbers normally will not result in death, they can reduce productivity. Different summer and winter pastures, with deworming medication when winter feeding, can reduce this problem.

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[2] A velvet yield function is estimated in Chapter IV.

Wapiti are susceptable to numerous other parasities (Kistner, Greer, Worley, and Brunetti 1982), but none are likely to cause major problems. Certain internal organs may be made unfit for sale by some parasities such as the liver fluke (*Fascoiloides magna*), but this does not affect the rest of the carcass. Brain worm (*Parelaphostrongylus tenuis*) is not currently a problem in Alberta, but is prevalent in Ontario and eastwards. This parasite is extremely pathogenic to wapiti and moose, and is carried by white tailed deer. Extreme care should be taken in importing animals from the east.

Leptospirosis and brucellosis can cause abortions and may be passed on or picked up from bison. These deseases are not wide spread in Canada. New stock should be tested for brucellosis. Deer farms in New Zealand do vaccinate for Leptospirosis as an outbreak can be costly and should be considered in Alberta if outbreaks occur. Vaccination for clostridium is also common in New Zealand though Kistner et al (1982) suggest that wapiti are probably resistant to most strains. Other wapiti diseases are either not serious or not likely to be common, [see Kistner et al (1982)].

Management

The level and type of wapiti management will be determined by the objectives of the game ranch. As the management level increases, so will the productivity of the herd and the number of animals the ranch can support.

Increased management goes hand in hand with increased cost and time commitment.

The most basic element of management is having knowledge about herd population and structure and gaining control over it. A round up should be carried out at least annually to enable counting, tagging, weighing, vaccinating, and sorting into different groups for management or sale. In New Zealand the deer are driven by a few people between paddocks. However the terrain is open grassland and the paddocks are small. In forested terrain with large pastures it would be easier to bait the animals into holding paddocks. More information is found later in the management cycle section below.

C. Moose

Moose are one of the major ungulate species of the boreal/mixedwood forest and, therefore, should be given consideration as a species for game ranching. They have several evolutionary adaptations which suit them to the area. They are not adversely affected by short periods of extreme cold (Kelsall and Telfer in Franzmann 1978) and their long legs facilitate travel through winter snows. They feed almost exclusively on browse and therefore utilize a resource that may be under utilized by other species.

The Soviet Union has had some success in domesticating moose (Knorre 1974). They imprinted them on man by bottle rearing calves, which must be done within a week of birth.

This process allowed them to be trained for such tasks as draught and milk animals. After training, the herd was allowed to free range without them straying far. They were habituated to return in the fall for mating and supplemental feeding. Subsequent calves were born on the farm and after ten days could be allowed to free range.

Moose are naturally solitary animals and do not normally form herds (Houston 1974). Home range size is extremely variable and can change seasonally. Lynch and Morgantini (1984) found that for Alberta moose, the home range averaged 11.7 km^2 in summer for males increasing to 43.1 km^2 in spring. Similarly females averaged 15.9 km^2 in the fall and 47.01 km^2 in winter.

Moose concentrate in areas of good feed in winter with densities of 8 to 15 per km^2 having been observed (Houston 1974). It is not known if essentially wild moose will take to supplemental feeding to maintain these densities. Domestic and captive moose will, however, take to supplemental feed (Schwartz, Regelin, and Franzmann 1984, Knorre 1974). Moose are therefore unlikely to be suitable for intensively managed ranching operations, unless the herd is started with bottle raised or semi domestic moose. Bottle raising moose is very labour intensive (Welch, Drew and Samuel 1985) with high mortality rates sometimes found.

Life History

Moose calves are born in late spring after an 8 month gestation period (Franzmann 1980), with peak calving period in late May to early June, . Normally one calf is born, but twins are common during population increases with triplets also reported. Twinning rates varied between 4.3% and 70.0% which Franzmann and Schwartz (1985) associated with habitat condition. Calf weights at birth are 11 to 16 kg. Calves begin eating forage at about 2 weeks (Schwartz et al 1984) and are weaned during the fall (Stringham 1974). The calf is driven away the following spring when the cow next calves.

Calf mortality during the summer can be high (exceed 50%) due to predation (Franzmann 1980, Wilton 1983, Franzmann and Peterson 1978). Black bears are the dominant preditor. Franzmann et al (1978) found predation was the cause of 9 of 10 deaths (one unknown death) in 15 radio collared calves. Black bears were responsible for 6 of those deaths. Winter calf mortality depends on snow depth, density, hardness, and persistence over time. These factors affect mobility which determines the ability to forage and escape predators.

The rut occurs from early September to late November with the peak period from late September to early October. Males stop feeding during the rut and can loose 10% to 20% of body weight (Lent 1974, Franzmann, LaResche, and Oldemeyer 1978). Moose are polygamous but do not form harems, although loose associations of one or two males and up to 10 - 20 females (Lent 1974) do occur in open habitat. Bisexual pairs are the norm for forest dwelling moose. Bulls increase their movement during the rut and there is some evidence that North American cow moose seek males (Markgren 1974a) or move to traditional rutting areas (Lent 1974). Agressive behavior is found between males and between females in estrous. Females are receptive for 7 to 12 days but are in estrous for less than 24 hours (Franzmann 1980). Males will remain with the females for this period. Females may come into estrus several times with 20 - 22 days between periods (Franzmann 1980). The first estrus may be a silent heat (Simpkin 1965).

The importance of the sex ratio is related to population density. Due to the solitary nature of moose, in low densities an unbalanced sex ratio decreases productivity and spreads out the calving period (Lent 1974). However, in high density populations, unbalanced sex ratios as high as 10♂:100♀ does not affect productivity (Markgren 1974a).

Like wapiti, moose calving rates have been related to body weight (Saether and Haagenrud 1983). One calf is usually produced by the two and three-year olds, (Franzmann and Schwartz 1985) after which twins are common. Russian domestication experiments (Knorre 1961) found adult cow moose had an average fecundity rate of 1.36 with cows first calving normally as three-year olds. The peak production years are four and five-year olds after which there is a slight decline (Saether and Haagenrud 1983). Markgren

(1974b) put the most productive years between 5 and 11 years, with an 18 year-old known to produce a calf (Franzmann 1980). No evidence of an inverse relationship between the previous and current years calving was found (Saether et al 1983). The widely varying calving rates observed (Simpkin 1974, Franzmann et al 1985, Markgren 1974b) are, therefore, probably largely a function of habitat quality affecting the animal condition. The sex ratio at birth is between 55% and 58% males (Markgren 1975a).

Adult mortality is low until at least 10 years of age. Major causes of death are predation and disease. In one Minnesota study all deaths for animals over 5 years was due to *P. tenuis* (Peek, Urich and Makie 1976).

Nutrition

Peek's (1974) review of moose feeding studies showed that moose are primarily browsers with some use of aquatic vegetation in early summer if available. Renecker and Hudson (1985) found in spring, aspen and poplar bark becomes important in the diet (39% of the time) before the spring flush. As foliage becomes available,it was the primary dietary item until senescence. In the fall forbs and leaf litter are consumed with browse, until prevented by snow crust, when twigs are primarily browsed upon. Prefered browse wpecies for the boreal/mixedwood forest are primarily willow and Saskatoon serviceberry, with secondary browsing on red-osier dogwood (*Cornus stolonifera*), trembling aspen and pin cherry (*Prunus pennsilvanica*)(Peek 1974, Nowlin 1978).

It has been shown (Gasaway and Coady 1974, Schwartz et al 1984, Renecker and Hudson 1985,) that moose display a seasonal pattern in their energy intake. The seasonal low is midwinter (late Feburary to April) corresponding to a decreased metabolic rate and weight loss. The high is in summer (May to September) corresponding to a weight gain period. Renecker and Hudson (1985) found a mid-summer dry matter intake of 129 g/kg $BW^{.75}$ and a mid-winter dry matter intake of 38 g/kg $BW^{.75}$ with a digestibility of 68.9% and 44.5% respectively for the boreal mixed wood forest. They calculated a digestible energy requirement of 751 KJ/kg $BW^{.75}$ for weight maintenance.

While most cervids can be introduced to supplimental feed fairly easily, moose are more difficult. Knorre (1974) showed that domesticated moose can be trained to return for supplemental feed and Schwartz et al (1985) found that captive wild moose will take readily to a pelleted ration. The major problem is providing enough roughage in the ration. Schwartz et al (1985) formulated a ration that calves were able to gain weight through the winter and produced heavier adults.

Health

Moose are susceptible to a wide variety of endoparasites and ectoparasities, but few are pathogenic or seriously affect moose in the wild. However they seem highly susceptible to disease in a captive environment (R. Hudson, pers. comm.). Anderson and Lancaster (1974) give a detailed coverage of the various parasities. The major pathogenic parasite of moose in North America is *P. tenuis* which is suspected of controlling moose distribution in eastern North America.

Elaeophora schneideri is an arterial nematode normally found in wapiti that is pathogenic. Its distribution is uncertain, but it is found in North American big game species (Anderson and Lancaster 1974) with the vector being horse flies (*Tabanidae*). Clinical signs are blindness and occular abnormalities, circling, uncoordination, nystagmus, necrosis of the muzzle and nostrils, dry gangrene of the ear tips, and abnormal antler growth.

The giant liver fluke (*F. magna*) is found in moose, however they are not suitable as final hosts so other cervids such as deer and wapiti must be present. Moose are particularily susceptible as they are infected by eating aquatic vegetation on which the cercariae are encysted. The adult flukes cause liver rot in the moose. Infections have been found to vary geographically from 17% to 87% (Anderson and Lancaster 1974).

The major ectoparasite is the winter tick (*Dermacentor albipictus*). This is a one-host tick that climbs onto moose in the fall and leaves in the spring. Tick populations seem to occur in cycles with massive buildups in some winters. A case of over 13,000 ticks on one moose was reported in Ontario (Addison, Johnson and Fyvie, 1979). There is some belief that moose population cycles may be associated with tick population cycles (C. Blyth, Warden, pers comm.) in Elk Island National Park. While the ticks in themselves are not likely to be a primary pathogen, in large numbers they can seriously weaken an animal through blood loss and cold stress during the most stressful period of the year. This makes the animal susceptible to other mortality factors.

Management

Management for moose and the other two species is to a degree contradictory. Clearing land for bison and wapiti grazing decreases the amount of browse available for moose. Habitat management for moose means leaving more forest cover and emphasing browse production. In particular willow areas should be reserved for moose winter feed. Clearing activities should concentrate on keeping the cleared areas small and with irregular edges. This will maximize the benefit of the clearings for both moose and wapiti.

Some interspecific competition for winter browse can be expected between moose and wapiti or deer if they are wintering in the same area. Some competition is reduced by moose feeding at a higher strata than wapiti or deer due to their larger size. Dietary overlap occurs for all major browse species (Prescott 1974, Stevens 1974). However spatial overlap is not likely as moose spread out while deer and elk tend to congregate. A winter feeding program for deer and elk would reduce any competition and could be used to draw them away from primary moose feeding areas.

If moose are to be raised intensively then domestication procedures as described by Knorre (1974) should be used. This option depends on the availablity of domesticated moose or calves under one week old. Semi-domesticated moose can be habituated to supplimental feed in winter and to form loose groups. This will allow a higher population to be maintained. With a higher density, ticks are more likely to be a problem. However, domestication should allow insecticide treatment for ticks if a winter round up is practiced. Keeping the moose in different pastures in fall and in spring should also reduce the tick problem.

D. Management Cycle

The management cycle for an intensive bison and wapiti ranch is described in this section. A less intensive ranch will omit some of the activities such as dividing the wapiti into breeding herds and changing breeding males. If moose are included, the activities will depend on the degree of control over them. Management of moose will probably be reduced to a December round up and sorting of those to be sold.

January - March

Bison and wapiti cows should be kept in separate paddocks and feeding levels should be regulated to insure weight maintenance. Calves can be run with cows or kept separate. Wapiti bulls should be kept separately and feed regulated so that weight is maintained or limited to a 5% loss. If feasible, the date of antler button casting should be recorded. Bison bulls can be released into larger grazing paddocks if sufficient winter forage (particularly sedge meadows) is available. Some weight loss is not a problem.

April - June

A spring burning program in the main pastures should be carried out in early April after the snows have gone and the grass has dried. Burning will get rid of scenesent vegitation, recycle nutrients and prevent brush encroachment. Burning in three year intervals is suggested.

Once green-up occurs the animals can be put into pastures. The bison cows can be put in a larger pasture with the bulls. Bison calves will be dropped in May, however there is no need to handle them. Wapiti bulls and cows should be placed in separate paddocks that are small enough to allow continuous monitoring. Wapiti calves will be dropped in late May, or early June.

Bull wapiti are velveted in June with timing based on antler cast. Constant monitoring is essential as the velvet is in prime condition for only a few days. Velveting should be done at least twice a week based on the number of stags to velvet.

July - November

Summer grazing occurs in this period and a system of rotational grazing is recommended. Bison should be moved to a fresh pasture at the beginning of July to flush them. Breeding takes place from late July to mid August.

The wapiti rut takes place during September and October. If single sire mating is practised (as would be important on a velvet ranch) then cow wapiti should be separated into groups of 40 in separate pastures. When the cows are separated would be a good time to separate the calves for weaning. A selected prime breeding bull should be put in with each group of cows. After 42 days (two breeding cycles), the bull should be replaced by a two or three year-old bull for three weeks to catch any cows not breed by the prime bull.

December

By the beginning of December there is snow on the ground normally, and both bison and wapiti are ready to be moved into handling facilities (baiting may be necessary). Bison and wapiti should be put through the handling facilities and weighted, vaccinated, pregnancy tested and sorted into the different winter feeding or market groups. Bison calves should be tagged and separated for weaning. Wapiti calves should also be weaned if not done previously.

E. Institutional Background

Randall (1981) describes institutions as laws, constitutions, traditions, moral and ethical strictures, and the customary and accepted way of doing things. Institutions provide the setting or rules under which the economy operates, and reflect the moral and ethical views of society. They provide stability to society and yet are adaptable to the changing views and needs of society. The institutional setting is therefore very important to the establishment of game ranching. The current controversy over game ranching stems from the institutional change implicit with game ranching. The institutions will influence the form game ranching will take.

One of the most important institutions involves property rights. Property rights are the root of many objections to game ranching. Prior to the new Wildlife Act (1984), all live wildlife in Alberta was crown property, including zoo animals and privately held wildlife under licence. Game ranching and the trading in animals and animal products recognizes that some property rights must be granted to the game rancher. The new Wildlife Act transfers the wildlife property rights to the game rancher.

Wildlife property rights in Canada are inherited from the British. Under English common law, wildlife (*ferae naturae*) are *nullius bonis* (common property) (Tober 1981). However after the Norman conquest, the sovereign appropriated the property rights to game, some of which were transfered to property owners. With the decline of the sovereign's powers, parliment took over the responsibility of regulating game harvests. This history forms the institutional basis in Canada today where wildlife property rights rest with the crown, *de facto* public property. Wildlife becomes private property once it is reduced to possession (normally meaning killed).

In the past, there has been little agricultural interest in wildlife due to an absence of wildlife product markets, lack of tradition of raising wildlife, and sufficient wild populations for hunting. As a result, there was little pressure to change the assignment of property rights. However, since the mid 1970's there has been an agricultural interest in wildlife as potential markets for wildlife products have been realized. This interest was thwarted by the inability to own the animals and laws prohibiting the sale of wildlife products. There was a need to transfer certain rights of domestically raised wildlife from the crown to individuals and to establish regulated markets for wildlife products.

In order to protect wild game populations and regulate their usage, governments claimed ownership of all members of wildlife species, whether *ferae naturae* or not. The new Alberta wildlife act recognizes the domestic nature (*domitae naturae*) of game ranched animals and grants private ownership of them which also has a basis in English common law (Tober 1981).

There are precedences for private ownership. Bison have long been reclassified as domestic animals in Alberta south of the 22nd Baseline to permit their use in agriculture. Fish farming has also become an accepted practice. Since 1959 big game farms (primarily for viewing purposes), game bird farms, and shooting preserves have been permitted under licence. A limited transfer of property rights is in keeping with the changing values and needs of society. Public response to the two Big Game Discussion papers (1984 and 1986) was in favor of game ranching (J. Bunnage, Alberta Agriculture, pers. comm.), although resistance to the idea was expressed by organizations such as the Alberta Fish and Game Association and the Alberta Wilderness Association.

The Wildlife Act (1984) and the regulations persuant to that act (Captive Wildlife and Captive Wildlife (Ministerial) Regulation) govern game ranching in Alberta. Game ranches require a Big Game Farm Permit and must be located on at least 24.3 ha of privately owned land or in a Metis Settlement. The permit states the species of animals permitted. Annual inventories must be submitted along with monthly transactions records including births and deaths. All animals must be ear tagged and tattoed. The requirement to register all births within 30 days effectively precludes extensive game ranches with poor animal control.

The regulations also establish a Big Game Farm Product Buyer's Permit allowing trade in animal products (excluding meat) between farms and buyers. The sale of meat from game animals is currently not permitted and moves to legalize meat sales are opposed by groups who believe that it could increase poaching of wild populations. Paid hunting is specifically prohibited on game ranches under the Wildlife Act.

The situation regarding game ranching varies from province to province. In general, the eastern provinces permit game ranching with exotic species but not native species, while western provinces permit native species ranching but not exotics. Manitoba is the dividing point, they had allowed game ranching until December 1986, when it was prohibited. British Columbia allows bison ranching under licence and has just recently permitted game ranching of fallow deer on a trial basis. Saskatchewan regulations are similar to Alberta's but allow meat sales. The Yukon and the Northwest Territories have game farm licences and are favorable to the establishment of game ranching. However, native land claims may delay widespread establishment. In summary, most western jurisdictions are currently reviewing their policies towards game ranching. Means are established to raise and sell live animals but the selling of products, in particular meat, is still in question in Alberta.

The cultural traditions regarding wildlife vary widely throughout the world. This is important both in respect to markets for products and the views of a multicultural Canadian society towards wildlife. Canadians traditionally view wildlife as a natural heritage to enjoy for sport hunting, viewing and other non consumptive uses. The concept of raising wildlife is still relatively new. Native Canadians view wildlife as a harvestable resource that previously was the foundation of their economy and still is in remote areas, although there is no tradition of rearing wildlife.

Europeans have quite a different tradition. In most countries, wildlife belongs to the landowner. This has led to the development of large deer parks with intensive management by hunting clubs charging high fees. The meat from animals killed is partly kept by the hunters and the remainder is sold. Well established markets exist for game meat. It commands a premium price over domestic animal meats. These markets have fueled an international trade in game meats with a 1978 volume of 51,955 tons, much of this in small game (Krostitz 1979). West Germany is the largest importer accounting for 37% of the volume. German demand is for "wild" meat and it is uncertain what the demand and discount will be for "farmed" meat.

The Orient also has a tradition of wildlife usage. Traditional oriental medicines are made from natural ingredients such as herbs and animal parts. One highly valued ingredient used in many medicines, is the velvet antler. It is bought frozen, then dried and retailed in thin slices. Korea is the major world velvet importer. The People's Republic of China and the Soviet Union have large deer farms expressly for producing velvet antlers. China and the USSR have been the major velvet producers, but in recent times New Zealand has become a major exporter. Antlers from the larger northern Wapiti are perceived to be of higher quality than from Red Deer. Other deer parts used in medicines include tails, penises, and sinews (Anderson 1978).

Game ranching for commercial purposes, while old in the orient is new to the rest of the world. The general world decrease in wild populations has spawned an interest in producing wildlife products from captive animals. Attractive prices for these products from captive animals compared to traditional agricultural products supports the interest. There are potential domestic markets for game products amongst the cultural groups in Canada who traditionally use game products. Game ranching can, therefore, be institutionally acceptable if it is seen as separate from wild game populations and not endangering wild populations.

III. ECONOMIC THEORY

For game ranching to have potential as a feasible economic activity for Northern Alberta, it must satisfy two criteria. First of all it must have an efficient production process. Suggestions of resource use inefficiency under traditional agricultural activities were used in some of the first arguments for game ranching. The argument that native herbivores can utilize more of the available vegetation than cattle and, therefore, have a lower cost of production, is an example. The second criteria is that game ranching must have a positive net present value that is higher than the net present value for other mutually exclusive land uses. These criteria orignate in the fields of production economics and capital budgeting.

This chapter contains a review of production theory and the manner in which it applies to game ranching. The criterion for efficient production is presented along with the manner in which linear programming can be applied. The section on capital budgeting covers the basis for determining a project's net present value. The chapter concludes with a look at welfare economics and how society can evaluate game ranching.

A. Production Theory

The game rancher is a producer whose goal is assumed to be profit maximization. Profit maximization requires decisions about the combinations of inputs (such as habitat improvement and supplemental feed), outputs (such as meat and breeding sales) and the production process. There are three basic decisions to be made:

1. What to produce;
2. How to produce;
3. How much to produce.

Production theory deals with the efficient allocation and transformation of resources (inputs) into products (outputs) subject to certain constraints. The constraints can be both resource and technical in nature. The basis of the theory is the production function. The production function is a technical relationship that describes the transformation of inputs into outputs under the best management. The biological relationships involved in game ranching are described in the next chapter. The general production function can be described algebraically as:

$$F(y_1,\ldots,y_n;x_1,\ldots,x_m)$$

where x_i are the inputs; and y_i, the outputs. The profit maximization objective of the producer is subject to technical constraints. This relationship is represented as:

$$\text{maximize: } \pi = \sum_{i=1}^{n} p_i y_i - \sum_{j=1}^{m} r_j x_j$$

$$\text{subject to: } F(y_1,\ldots y_n,\ x_1,\ldots x_m) = 0$$

$$y_i \geq 0 \qquad i = 1,\ldots.n$$

$$x_j \geq 0 \qquad j = 1,\ldots.m$$

where π is profit, p_i, the unit price for y_i; and r_j, the unit price for x_j.

Production decision rules can be derived from this problem under certain assumptions. These assumptions are:

1. The producer has perfect knowledge of input and output prices and has no control over them, he is a price taker; and
2. The producer has perfect knowledge of the technological relationship (the production function).

These assumptions facilitate the analysis of production decision rules. Game ranching in reality may not adhere completely to these assumptions. While the first assumption should hold for input prices, it may not hold for output prices in the initial stages of game ranching. The second assumption is not true as seen in the previous chapter, but the handling of uncertainity will be covered later. However the information available allows estimation of production functions.

First order conditions for profit maximization can be determined using the La Grangian method:

$$L = \sum_{i=1}^{n} p_i y_i - \sum_{j=1}^{m} r_j x_j - \lambda[(F(y_1 \ldots y_n, x_1 \ldots x_m)]$$

The first order conditions are:

$$\partial L/\partial Y_i = p_i - \lambda \partial F/\partial y_i = 0 \qquad i=1,\ldots,n$$

$$\partial L/\partial X_j = r_j - \lambda \partial F/\partial x_j = 0 \qquad j=1,\ldots,m$$

$$\partial L/\partial \lambda = F(y_1,\ldots,y_m;x_1,\ldots,x_m) = 0$$

The second order conditions are that the principal minors of the relevant Hessian determinant alternate in sign (Henderson and Quandt 1980, p.79). From these first order conditions, the decision rules can be derived.

How Much To Produce? This governs the level of output. The decision rule is derived as:

$$r_j = p_i \, \partial y_i / \partial x_j$$

It is stated as the value of the marginal product (VMP) of the *j*th input with the respect to the *i*th output is equivalent to the marginal factor cost (MFC) of the *j*th input (input price) for all inputs and outputs. An input is added until the marginal value of the output decreases to equal the input price with unlimited resources. This results in the general production rule of equating marginal revenue to marginal cost.

How To Produce? This governs the choice of inputs. The decision rule is derived as:

$$r_k / r_j = - \partial x_j / \partial x_k$$

It is stated as the marginal rate of technical substitution (MRTS) of input k for input j must equal the price ratio of input prices for k and j holding output and other inputs constant. This condition must hold for all input pairs. Between substitute inputs, one input is substituted for another until the MRTS equals the price ratio.

What To Produce? This governs the choice of outputs. The decision rule is similar to the input rule and is derived as:

$$p_k / p_i = - \partial y_i / \partial y_k$$

It is stated as the marginal rate of product transformation (MRPT) of product k for product i must equal the price ratio of product prices for k and i holding other products and inputs constant. This condition must hold for all pairs of products. Between substitute products, one product will be substituted for another until the MRPT equals the price ratio.

The problem is that no readily definable production functions are available for game production upon which we can use the tools of calculus for optimization. Current gaps in knowledge of biological relationships make a fixed proportion production function appropriate, such as a particular expected fecundity rate under good management or an expected velvet yield related to age. This type of analysis lends itself nicely to a technique called linear programming.

Linear programming is an optimization technique that allows the application of production theory by maximizing or minimizing an objective function subject to a set of constraints. The objective function takes the form:

$$\pi = p_1y_1 + \ldots + p_ny_n$$

The constraint equations are production functions containing a resource constraint. The functional form must be a fixed proportion production function and is characterized constant returns to scale (Doll and Orazem 1978). Constraints are written as:

$$a_{11}y_1 + a_{12}y_2 \leq X_1$$

$$a_{21}y_1 + a_{22}y_2 \leq X_2$$

Product y_1 requires a_{11} units of input x_1 and a_{21} units of input x_2. Product y_2 requires a_{12} units of x_1 and a_{22} units of x_2. X_1 is the total amount of x_1 available and X_2 is the total amount of x_2 available. a is the technical coefficient and represents the biological relationships such as weight, fecundity, and forage requirements.

Linear programming has the advantage of being able to solve a maximization problem of many possible activities subject to a large number of constraints. It creates a production possibilities frontier consisting of linear segments of the constrained equations.

B. Capital Budgeting Theory

While the game rancher is a producer, he is also a businessman and as such must make sound investment decisions. The game rancher must consider the opportunity costs involved in game ranching. The capital invested in a game ranch could be invested elsewhere, and thus has an opportunity cost that is usually embodied in the cost of capital. In addition, there are alternative production projects for the resources available to the potential game rancher such as cattle ranching. Before a potential game rancher or investor will invest in a game ranching enterprise, the enterprise will have to earn a return that is higher than the opportunity cost of the resources. Capital budgeting theory provides the framework for evaluating projects and making efficient investment decisions. Included in the process is an assessment of project risk.

Capital budgeting theory deals with the process of analysing the capital expenditure on a project by examining the relevant cash flows. It provides the basis for comparing different investment opportunities and choosing among them. Capital budgeting information is also required by outside persons or agencies interested in investing in game ranching. An objective of an investor is to maximize his wealth. As such, there are three criteria that capital budgeting decisions must meet (Bringham and Gapenski 1985):

1. All relevant cash flows throughout the entire life of the project must be considered;
2. The time value of money must be taken into account; and
3. When selecting between mutually exclusive projects, the project selected must maximize the firms wealth.

There are a number of methods used to make capital budgeting decisions. Some of the more common ones are: the payback period, the profitability index (PI) (or cost/benefit ratio), the accounting rate of return (ARR), the internal rate of return (IRR), and the net present value method (NPV). Only the NPV satisfies the above criteria. However some of the others can be useful. The payback period provides an indication of when a project will recover the initial investment. To the extent that increased risk is associated with a longer payback period, this method can help in evaluating projects. The PI, IRR, and NPV all give the same accept/reject decisions on independent projects; but when comparing mutually exclusive projects, they can give conflicting results.

The NPV is the only method that consistently satisfies the third criterion. The PI compares different project's net present value on a relative basis. If the two projects are of different sizes, the project with a large investment cost may get a lower PI than a smaller project, even though its absolute net present value is higher. The IRR is the discount rate that gives a project a net present value of zero. The IRR can give decisions that violate the third criterion if the two projects are of different size or the timing of the cash flows are different. Under certain circumstances, multiple IRR's can be found or there is no solution (Bringham and Gapenski 1985). The NPV is therefore the preferred method of project evaluation, as it will give the game ranching investor the ability to compare game ranching to other land use options.

The NPV identifies all relevant cash flows (positive and negative) and discounts them by the cost of capital. The discounted cash flows are then summed as follows:

$$NPV = \sum_{t=0}^{n} CF_t/(1+k)^t$$

where t is time (usually in years), CF is cashflow and k is the cost of capital. Care must be taken to ensure only relevant cash flows are included. Only incremental cash flows should be included and so expenses already paid are not included, but opportunity costs are. The interest payments on borrowed capital are also not included as they are covered in the discounting process. All cash flows are taken on an after-tax basis including tax credits and allowances.

The NPV method is based on discounting all cash flows by the cost of capital. The cost of capital (or discount rate) is comprised of three components: the time value of money or real discount rate, an inflation component, and a risk component. If inflationary considerations are not included in future cash flows, then the inflation component must be removed from the discount rate.

All enterprises have some degree of risk to them which must be considered when an investment decision is made. When the cash flows for a prospective project are forecast, they are expected values. The expected value is used in the statistical sense and it has a variance associated with it. Uncertainity can be found in most parameters from fecundity rates to the velvet price. The variance in expected cash flows due to uncertainty can have major implications for the project's return and feasibility. For this reason investors normally want to be compensated for risk.

The discount rate should be a weighted average cost of capital from all sources. In the case of owners equity, it is the opportunity cost. The Modigliani-Miller Model shows that the capital structure of an enterprise should not affect its cost of capital in the absence of taxes. The tax effect can reduce the cost of capital with increased leverage depending on relative tax rates for corporations, stock income and debt income. This effect is moderated by bankruptcy costs causing the debt costs to increase with increasing debt, which produces a U shaped cost of capital (Bringham and Gapenski 1985). As game ranching is a new and risky industry, extensive debt financing is unlikely to be available. The cost of capital will be treated in this analysis as equity.

There are two types of risk that are present in capital budgeting decisions, corporate risk and market risk. Corporate risk is the uncertainty involved in a particular project's net revenue. A sensitivity analysis can be done to give an indication of corporate risk. Market risk is a parameter that measures how well a firm performs in relation to the economy (also called beta risk).

BETA: $\beta_i = r_{iM}(\sigma_i/\sigma_M)$

Where σ_i is the standard deviation of the ith security and r_{iM} is the correlation coefficient between the ith security and the market portfolio.

A firms performance is compared to the stock market. If a firm performance matches the stock market performance, then it is as risky as the market and $\beta=1$. If the performance is twice as volitale as the market, then $\beta=2$. If the performance is counter to the market, beta will be negative. Beta is usually calculated from past firm performance or that of similar firms.

In the case of a game ranch, the corporate risk would be of interest to an owner operator. It is a measure of the risk of the owner's investment and it is a subjective decision on whether to take the risk. Market risk is primarily of interest to the well diversified investor buying shares in a game ranch and measures the risk the investor cannot diversify away. The investor would want to be compensated for market risk by an additional return on investment which is reflected in the cost of capital.

The approach can be taken that a game ranch is an alternate investment to the stock market. As such it should earn a return comparable to the return on an equally risky stock. One model used to predict the required rate of return on a stock is the Capital Asset Pricing Model (CAPM). Attempts to validate the model show that it overprices stocks (Bringham and Gapenski 1985). However it is still useful for getting an estimate of the required rate of return.

The CAPM proposes the existance of a Capital Market Line (CML) which is a linear relationship between risk and return. This relationship has an intercept of the risk free rate of return (R_f) and is tangent to the efficient set of risky portfolios. The point of tangency M, is the market portfolio which when the market is in equilibrium, contains all assets in proportion to that assets fraction of the market's value (Bringham and Gapenski 1985). Investors will maximize their utility by holding portfolios that combine risk free assets and the risky portfolio (M). These portfolios will lie on the CML and will vary depending on the individuals risk-return indifference curve.

$$\text{CML: } k_p = R_f + [(k_M - R_f)/\sigma_M]\sigma_p$$

where k_p is the portfolio's required return; k_M, the return on the market portfolio; σ_M, the market portfolio's standard deviation; and σ_p, the portfolio's standard deviation.

From the CML we can derive a relationship between risk and the required rate of return that individual securities must show for them to be part of the market portfolio. The relevant risk is market risk (a security's beta) as all investors are assumed to be well diversified. The relationship is called the Security Market Line (SML).

$$\text{SML: } k_i = R_f + \beta_i(k_M - R_f)$$

As game ranching is a new industry, there are no past data or similar firms upon which to base a calculation of beta. The returns to game ranching will rely initially on markets for breeding stock, and eventually on markets for velvet and venison. High breeding stock prices depend on new investment in game ranching. As game ranching is a new risky enterprise, investment is more likely in times of bull markets. Venison is also likely to be a luxury good. Therefore the return to game ranching is likely to follow the trend in the stock market. If we assume that game ranching returns will follow the trend in the market place (that $r_{iM} = 1$), then the beta for game ranching will be:

$$\beta_{GR} = 1(CV_{GR}/CV_M)$$

where CV_{GR} is the coefficient of variation[3] of the game ranch divided by the market coefficient of variation. Assuming $r_{iM}=1$ places a conservative estimate on β_{GR}, as any other value for r_{iM} would reduce the estimate of β_{GR}. The discount rate derived using CAPM will account for the opportunity cost of capital. The undiversified game rancher must determine if the NPV is large enough to compensate for corporate risk.

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[3] To allow comparison of the market and game ranch returns, the coefficient of variation is used for the standard deviation.

C. Welfare Theory

Game ranching involves a redistribution of wealth and some institutional changes. It is therefore important that game ranching be viewed in terms of achieving societal goals and improving society's well being. A transfer of wealth can arise from substitution of land uses and property rights transfer.

Game ranching may represent a change in social welfare. Changes should only be undertaken if they lead to an increase in social welfare, movement towards the social optimum. However, there is no generally accepted means of determining the social welfare function and ranking states of social welfare. Changes in social welfare can be broken into two components, efficiency and equity. By definition all points on Grand Utility Frontier (including the social optimum) are efficient (e.g. see Randall 1981). Different points represent different distributions of wealth.

Economists are usually concerned with questions of efficiency and there are several accepted criteria for determining efficiency such as the Kaldor/Hicks compensation criteria (Just, Hueth and Schmitz 1982). A project has social merit if it is efficient. Questions of equity are normally involved as well in empirical analysis. Economists can only identify the gainers and the losers, and the magnitude of gains and losses. It is society through institutions such as the political and legal process that determines whether the redistribution of wealth is acceptable or not.

Institutions are the norms of society and provide the setting or rules under which society operates. Institutions must provide the stability that society requires, but must also be responsive to the changes in society. Property rights are an important institution with a bearing on game ranching. Property rights define the rules as to how wealth is distributed. Property is defined as a bundle of rights to control. The strands of the bundle can be distributed to the state, owners, users and others (Ciriacy-Wantrup 1968). Property rights are assigned so as to make the self-interest of individuals serve the best interests of society. If through time the interests of society change, then the assignment of the strands must be changed to reflect the new interests. The new Wildlife Act reflects a reassignment of certain strands. The redistribution of property rights will cause a redistribution of wealth.

An assessment of benefits to society should be based on equity and increasing economic efficiency. While the NPV analysis done in this thesis is an analysis based on a private business venture and does create some externalities, it does provide an indication of economic efficiency. A comparison of the NPV for game ranching and the NPV for other land uses such as logging, will indicate whether or not game ranching is more efficient and can meet the compensation criteria. In dealing with equity, society must determine if the distribution of benefits from game ranching significantly alters the current distribution of benefits from the landbase, and if so, whether or not the new distribution in the best interests of society.

IV. MODEL DEVELOPMENT

A. Problem Statement

The potential game rancher faces many production choices constrained by the biological characteristics of the animals. There are three potential animal species (bison, wapiti, and moose) each with a number of potential products (breeding stock, meat sales, and wapiti velvet sales). The herd sex and age structure may also vary depending on the products produced. The goal of the efficient producer is to select the product mix and corresponding herd structure that will maximize net revenue.

A major consideration is the limited breeding stock available for initial purchase. There are approximately 2,800 wapiti and 5,000 bison on farms in Alberta (L.Renecker, pers. comm.). There are no significant numbers of moose available for purchase. As a result, a commercial game ranch will not be able to purchase a complete breeding herd but will go through a stock-up phase to bring the herd up to carrying capacity. This phase is likely to take at least ten years. During the stock-up period the relative product prices are likely to change, thus changing the production strategy.

The problem is one of determining the efficient production strategy under different product prices. Several likely price scenarios can be postulated by drawing on economic theory. The operation of the ranch must then be followed from establishment through to maturity in order to analyse its investment potential. As there is considerable uncertainity in both production factors and product prices, a probability function must be determined for ranch performance. The probability function results in an expected NPV and associated standard deviation. The sensitivity of the expected NPV to changes in the price scenarios must also be determined.

B. Methods

Linear programming is a method of applying production theory to find an optimum production strategy. The current state of knowledge regarding game ranching production functions dictates that linear production functions be used. Linear programming is used to optimize the production strategy of the game ranch at maturity. The program selects the products that should be produced and the herd structure that is necessary to produce them based on the available resources. Post optimal analysis allows an examination of the price range for which the solution is valid. Parametric programming shows the manner in which the structure changes with price changes.

The linear program addresses the production of a fully stocked ranch. As noted, there will be a lengthy stock up phase. The investment criterion applied is the net present value (NPV). To determine the NPV, cash flows must be projected from establishment to maturity. To generate cash flows, a systems model is developed which simulates the game ranch operation from establishment through to the fully stocked position derived in the linear program. The yearly cash flows are then discounted to determine the NPV.

Before a ranch NPV can be determined, the risk adjusted discount rate must be derived. The capital asset pricing model (CAPM) requires that the coefficient of variation for the ranch cash flows be known, to derive the required rate of return (discount rate). For most biological parameters and prices, a high, low and most likely value can be obtained from literature and a triangular distribution is assumed. By performing a Monte Carlo simulation on the systems model using the risk free interest rate, an assessment of the risk associated with the uncertainty in cash flows can be made (Brigham and Gapenski 1985). By using the CAPM derived discount rate, the systems model can generate the expected NPV using expected parameter values.

Product prices are likely to change over the time period simulated in the model. The next section provides a discussion of likely price changes. A sensitivity analysis is carried out later using different variations of the price scenario in the systems model.

This analysis is a partial equilibrium analysis. Game ranching will only make up a very small part of the agricultural economy. Variables that are exogenous to this analysis are, therefore, unlikely to be significantly effected thus making a partial equilibrium analysis appropriate.

C. Prices and Trends

Future product prices are critical factors in determining the feasibility and structure of the game ranch. It is unreasonable to expect current prices to prevail within the long timeframe considered in this study. Likely product price trends are postulated in this section. The trends are the basis for the prices used in the linear program and systems model.

The major source of uncertainity are the future prices of wapiti products. Bison markets currently exist, although not well organized, and market development with increased production should stabilize prices. Since both supply and demand are likely to shift, no predictions can be made about bison price trends and current prices are used. Moose meat is assumed to sell for the same price as wapiti meat.

Due to the lack of a well established market for venison[4], current prices (where it is legally sold) vary across the country. The high prices seen for fallow deer venison [$11.00/kg[5] (Renecker, 1987)] in eastern North America are at the top of the demand schedule.

Several factors can cause movement in the equilibrium price. The outward shift in the venison supply curve will be limited by the biological growth potential of the herd and the price of velvet. Only cull animals are likely to be slaughtered while the herd is expanding. Given current numbers and the New Zealand experience, herd expansion is likely to take about 20 years (Hudson et al, 1987). The slaughter age for males depends on the velvet price (above a certain velvet/venison price ratio, males should be retained for velvet production). Venison market development can shift the effective demand curve outward.

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[4] Venison refers to wapiti and moose meat.
[5] All prices are dressed weight except for bison feeders.

The time path venison prices are likely to follow is difficult to predict. While males are kept for velveting, no large increase in venison supplies or market development is likely. Once venison starts to be produced, increased supplies may coincide with market development keeping the price more or less constant. No change in venison price is assumed in the model.

The international velvet market is well established and thought to be inelastic (S. Wong*, pers. comm,). The percieved higher quality of Canadian velvet over New Zealand velvet, means Canada could capture some of the New Zealand market share. The New Zealand velvet price has shown relative stability since 1981 (Hudson et al. 1987). Short term (five years) price stability for Canadian velvet is likely while herds are being established. As production increases, prices are likely to drop due to inelasitic demand. The drop will be muted by increasing market share. Velvet prices in the model are assumed to be constant for the first five years and then fall 2.5% per year to an arbitrarily set lower limit of $55/kg.

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*Tak Tie Ginseng Firm Ltd

In a rational market, the equilibrium price for live animals should reflect the present value of future net revenues from the animal. In the case of males it will be the value of the velvet and venison produced minus costs, and for females the value of offspring and venison produced minus costs. Sandry and Zwart (1986) expressed the present value of a male at birth as:

$$\pi_0(\sigma) = p(i,\sigma)w(i,\sigma)e^{-r\sigma}+\int_0^{\sigma} p_v(i,t)w_v(i,t)e^{-rt}dt - ci\int_0^{\sigma} e^{-rt}dt$$

where $\pi_0(\sigma)$ is the value of a male at birth slaughtered at age σ; p, unit price of venison; w, slaughter weight; t, age of the animal; c, unit costs of inputs over the life of the animal; i, vector of inputs per unit time; r, interest rate; σ, slaughter age; p_v, velvet price; and w_v, weight of velvet produced by an animal at age σ having been fed inputs i. Realization of this price assumes a market for male velvet animals. As future velvet prices fall, a fall in male live prices will follow to a long run price based on slaughter value. In the models male prices are assumed to be constant for the first five years and then fall 10% per year to the slaughter value.

The expression for females (Sandrey and Zwart 1986) is:

$$P_0(\sigma) = \tfrac{1}{2}[\pi_0(\hat{\sigma})+P_0(\hat{\sigma})]\cdot\int_0^{\sigma} F(i,\sigma)e^{-rt}dt+p(i,\sigma)w(i,\sigma)e^{-rt}$$
$$-ci\int_0^{\sigma} e^{-rt}dt$$

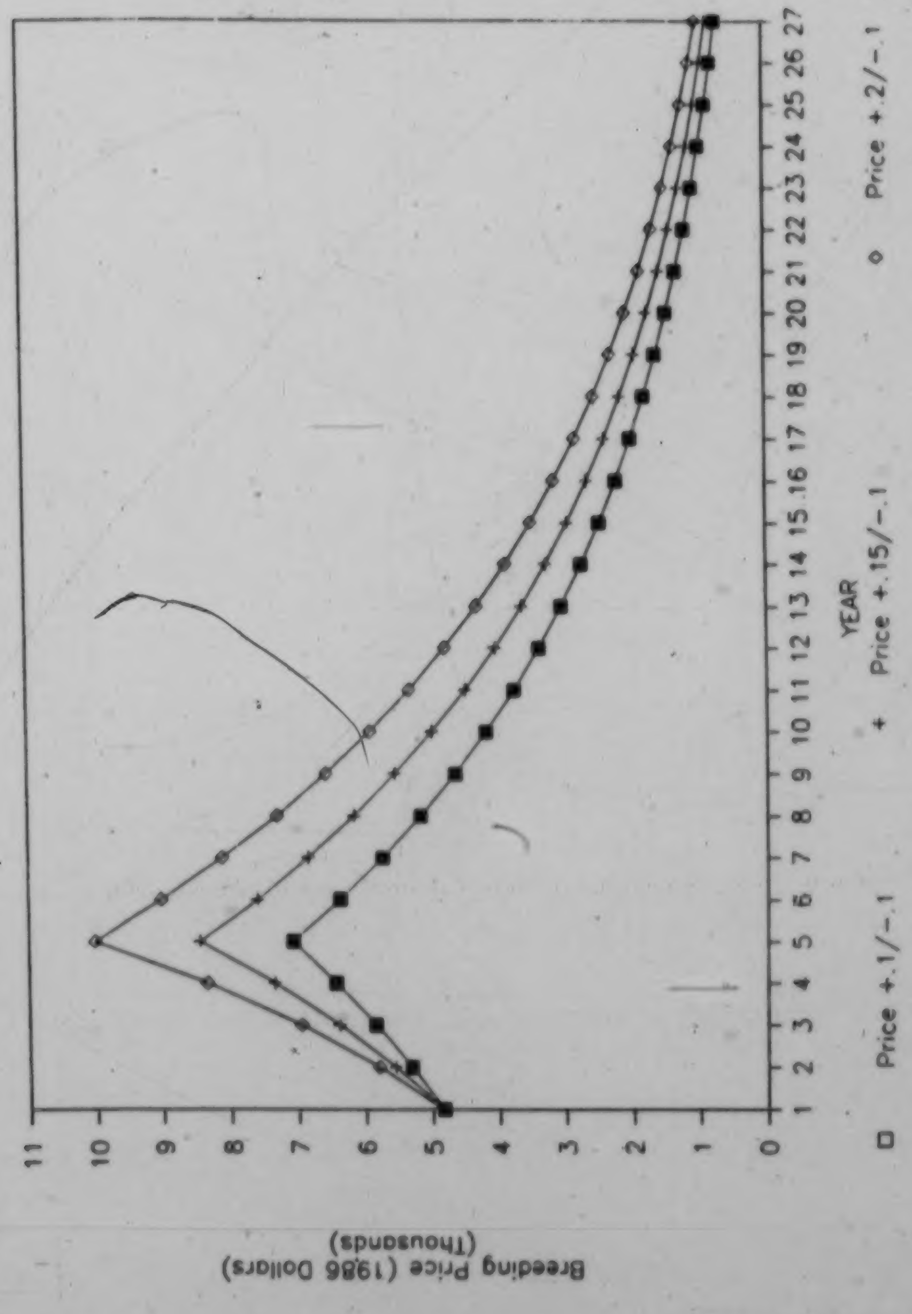
where $P_0(\hat{\sigma})$, the value at birth of a female slaughtered at age $\hat{\sigma}$; and $F(i,\sigma)$, a probability function reflecting the birth rate and mortality of the female. The problem arises that P_0 is endogenous making estimation difficult. Female prices are likely to be far more volatile than male prices as they depend on producer's expectations of future female prices. In the long run female, prices are likely to reflect slaughter prices when new producers are not entering the market (expected NPV of an new operation is zero) and existing producers have all the breeding stock they require. In the short run as interest is generated in game ranching, demand is likely to shift out and prices will rise. Supply shifts are constrained by the biological productivity of the herd.

The scenario assumed in the model has female prices increase for five years as demand increases with expectations. Prices then decrease as the increase in supply exceeds demand and more realistic expectations are made of future prices. The base scenario assumes an increase of 15% per year for five years followed by a decrease of 10% per year until the slaughter price is reached. Figure IV.1 shows the effect of price increases of 10, 15 and 20 percent per year for the first five years. These scenarios are used in the sensitivity analysis.

D. Model Parameters

The results of the linear program and simulation model are dependent on the physical, biological, and economic parameters (technical coefficients) used. A probability distribution is specified for each parameter in this section

FIGURE IV.1 LIVE PRICES FOR 3 YEAR OLD FEMALES FOR DIFFERENT RATES OF PRICE INCREASE



and expected values are used in the models. For most parameters a triangular distribution is used. Values have been obtained from published sources or estimated where not available. In a few cases where data are available, both expected values and standard deviations are derived by statistical means.

Physical Parameters

The physical parameters are used as resource constraints in both models. The parameters are based on the Kikino Wildlife Ranch which has an area of 2,200 ha. The ranch is located in the boreal mixedwood forest region and is primarily forested. Vegetation type areas were estimated by Renecker and Biewald (1985) and are shown in Table IV.1. It is assumed that up to one third of the aspen area (1205 ha) can be cleared for habitat improvement.

No forage production data are available for the ranch, but the literature provides data from some similar areas. These values are used to estimate forage availability (Table IV.1). Herbaceous forage and browse are identified as important forage classes since feed requirements are based on dry matter intake. The total amount of herbaceous forage available is 747,078 kg, of which 373,539 kg (50%) is available for consumption based on accepted range management practices (Stoddard and Smith 1955). The total amount of browse available is 32,512 kg, of which 19,510 kg (60%) can be consumed while still permitting adequate plant recovery (Telfer and Scotter 1975).

The Lac La Biche area receives appreciable snowfall (mean days greater than 5 cm) from November through March (Environment Canada 1982). Mean snow depth is greater than 20cm from the beginning of January until early April (Dept of Energy, Mines and Resources 1970). Therefore, the potential winter feeding period is from January through mid

TABLE IV.1 KIKINO WILDLIFE RANCH FORAGE PRODUCTION

Habitat	Herbaceous Production (kg/ha)	Browse Production (kg/ha)	Area (ha)	Herbaceous Forage (kg)	Total Browse (kg)
aspen-poplar	42[1]	8[2]	1,807	75,894	14,456
black spruce	10[1]	0[2]	196	1,960	0
sedge meadow	4,018[2]	129[1]	140	562,520	18,060
clearings	2,808[1]	0	38	106,704	0
TOTAL			2,181[3]	747,078	32,516

[1] Kocaoghu and Bennett 1983
[2] Bishoff 1981
[3] open water and corrals occupy an additional 27 ha

April. Some supplimental feeding will be necessary in December while animals are in holding pens prior to being put through the handling facilities. This gives a potential winter feeding period of 121 days.

Biological Parameters

There are seven biological parameteres included in the models. Mortality and fecundity[1] are age specific and are not known with a high degree of certainity. The rates found on a specific ranch will be largely a function of the management intensity and skill. A triangular distribution is specified for these parameters (Table IV.2). Most mortality in wild animals reported in the literature is directly related to predation and is, therefore, higher than would be

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[1] The average number of young born per female.

TABLE IV.2 FECUNDITY AND MORTALITY DISTRIBUTION

		LOWEST	MOST LIKELY	HIGHEST	EXPECTED[1]
FECUNDITY					
Bison	2 Yr	0[2]		0.133[3]	0.066
	3 Yr	0.5[4]	0.8[4]	0.95[4]	0.75
	> 3 Yrs	0.6[4]	0.9[4]	0.95[3]	0.82
WAPITI	2 Yr	0[5]	0.75[6]	0.8[7]	0.52
	> 2 Yrs	0.65	0.95[6] [7]	1[7]	0.87
MOOSE	2 Yr	0[8]	0.42[9]	0.83[9]	0.42
	3 Yr	0.17[10]	0.92	1.0[11]	0.70
	> 3 Yrs	1.05[8]	1.36[8]	1.6[8]	1.34
MORTALITY					
WAPITI	Calf	0.02[6]	0.05[6]	0.1[7]	0.057
	Adult	0.01[14]	0.04[14]	0.07[14]	0.04
MOOSE	Calf	0.2[8]		0.5[8]	0.35
	1-5 Yrs	0.03[13]	0.05[14]	0.16[12]	0.08
	6-12 Yrs	0.07[12]	0.1[14]	0.16[12]	0.11
BISON	All Ages	.01[14]	0.04[14]	0.07[14]	0.04

[1] E(x) = (lowest + most likely + highest)/3
[2] Meagher 1978
[3] Halloran 1968
[4] Jennings et al 1983
[5] Kimball et al 1979
[6] Spires 1985
[7] Bubenik 1982
[8] Knorre 1961
[9] Schwartz et al 1985
[10] Simpkin 1965
[11] Franzmann et al 1985
[12] Van Ballenberghe 1983
[13] Peek et al 1976
[14] author's estimate.

expected on a game ranch. Table IV.3 contains the parameter values for the sex ratio at birth, daily dry matter intake and dressing percentage. These parameters are known with more certainity and no probability distribution is described for them.

Bison are primarily grazing animals and are assumed to consume 100% of their daily requirements from herbaceous forage. Moose are primarily browsing animals, as summer browse consists primarily of foliage which is not considered

TABLE IV.3 BIOLOGICAL PARAMETERS

Species	Sex Ratio at Birth(♂:♀)	Daily Dry Matter Intake	Dressing Percentage
Bison	50:50[1]	0.0225kg/kg BW [3]	54%[6]
Wapiti	50:50[1]	0.023kg/kg BW [4]	56%[7]
Moose	55:45[2]	0.038kg/kg $BW^{.75}$ [5]	49%[8]

[1] Assumed in absence of better information
[2] Markgren 1975a
[3] Jennings et al 1983
[4] Nelson et al 1982
[5] Renecker and Hudson 1985
[6] Halloran 1957
[7] Field, Smith and Hepworth 1973
[8] Calculated from 1968 Elk Island National Park harvest data

a constraint in the model, only winter browse consumption is included in the model. Wapiti are mixed feeders with summer feeding assumed to be 5% browsing (on foliage which is therefore not included in the models) and 95% grazing on herbaceous forage (Telfer et al 1979). Natural winter foraging is assumed to be 40% browse and 60% herbaceous forage. If fed hay however, minimal browsing occurs (H. Kozak pers. comm). Hay for winter feeding is assumed to be 90% dry matter.

Growth curves for each species are described below from Elk Island National Park data (Blyth, in prep):

bison ♂; $Y = 810 - 784.6732\ e^{-0.291X}$ (S.E.=.023)

bison ♀; $Y = 468 - 432.49\ e^{-0.481X}$ (S.E.=.05)

wapiti ♂; $Y = 418 - 394\ e^{-.448X}$ (S.E.=.07)

wapiti ♀; $Y = 313.5 - 299.5\ e^{-.666X}$ (S.E.=.105)

moose ♂; $Y = 265.333 + 110.872 \ln(x)$ (S.E.=.13)

moose ♀; $Y = 434.135 - 133.809/X$ (S.E.=.15) where *X* is age in years and *Y* is weight. These equations are based on extensively raised animals; intensively raised animals may have better growth rates. The variation refers to the herd mean weight variation, variation in individual animals is greater.

Wapiti velvet production is based on records from the Ministik Research Station (University of Alberta) and R. Alsager (a private rancher) on animals one to thirteen years old (N=103). Velvet weight is assumed to be a function of age. The data show antler growth increasing to age 10, before levelling off. A velvet production function is estimated by simple regression for animals two[a] to ten years of age providing the following equation ($R^2=0.60$):

$$Y = 1.4476 + 0.73933X \quad (S.E.=1.48)$$

where *Y* is velvet weight in kg and *X* is age in years. The coefficients are both significant ($P<.05$). Variation increases with age. Constant growth is assumed at age 11, and to decrease in year 12 to 9 year old weight.

Velvet is categorized into four basic grades (A to D) reflecting quality with A being the highest grade. Grade is a function of animal age and cutting date. The following grading is assumed (Bryan 1986):

1. Two year: 50% A4, 50% B4,
2. Three year and older:30% A1, 50% B1, 20% C1.

Few animals live to old age in the wild and with only limited experience in raising animals in captivity, little knowledge is available on the productive lifespans of animals or the mortality rates at older ages. Therefore the lifespan is arbitrarily assumed to be 12 years. All animals surviving to this age will be harvested at the end of the 12th year.

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[a] One year old animals are excluded because their velvet is not harvested and there is a lack of data for that age.

The herd sex ratio for breeding aged animals has a major effect on herd productivity. The sex ratios are the maximum number of females to males permitted. Jennings and Hebbring (1983) recommended a 10♂:1♀ sex ratio for large bison herds. Using farmed Red Deer experience as a guide for wapiti, extreme sex ratios of 80♂:1♀ have been used (Kelly and Moore 1978). However sex ratios of 40♂:1♀ (Spires 1985) are normally used and are assumed in the model. Moose are not generally gregarious animals, but under captive ranching conditions a sex ratio of 10♂:1♀ could be expected (Markgren 1974a) and is assumed in this study.

Economic Parameters

The year 1986 is considered year zero in this study. Project investment is assumed to occur in 1986 with production starting in 1987. All values used and generated will be in 1986 dollars. The consumer price index (CPI) is used to bring costs collected to 1986 dollars.

Capital Investment

The initial capital investment consists of the following: land, improvements (fences, corrals), ranch equipment, and initial breeding stock. Table IV.4 summarizes the investment costs except for breeding stock. The initial breeding stock investment is a variable in the simulation model. The number of animals purchased is input and the investment is calculated based on the animal prices summarized in Table IV.6.

In the case of the Kikino Wildlife Ranch, no land costs are realized as it is part of a Metis Settlement and the land cannot be bought or sold. However since land value represents an opportunity cost to other game ranches, current land prices in the area are used to enable this study to be of general value. The opportunity cost of Metis land is the value of alternate land uses, which can be substituted for the land value in Table IV.4. The difference between the value of alternate land uses and the land price should be added to the NPV. Current land value for bush land with improvement potential in the Lac La Biche area is $247/ha (Leo Reayon, NRS Reality, pers comm.) and 20% of this price is assumed for less productive areas such as muskeg.

Fencing is one of the largest capital expenditures. There are 24.4 km of external fences and 11.4 km of internal fences required at the Kikino Ranch (Renecker and Biewald 1985) for intensive management purposes. Fences consist of 1.9 m cyclone deer fence with external fences having an additional 2 top wires, one of which will be electrified. External fence construction costs including materials,

TABLE IV.4 CAPITAL INVESTMENT

Item		Life (Yrs)	Cost (1986 dollars)
land (2208 ha)			502,102
fences	external (24.4 km)	30	122,537
	internal (11.4 km)	30	53,899
landscaping (including dugouts)			5,850
corrals		25	20,000
equipment shed		20	5,000
weigh scales		15	1,547
squeeze	bison	25	2,905
	wapiti (from New Zealand)	25	4,000
tractor (60 HP) with front end loader		15	30,070
truck (4x4)		7	18,000
tools (including chainsaw & welding equipment)		10	2,000

labor, equipment, and fence line clearing are estimated at $5022/km and $4728/km for internal fences.

Under all but the most extensive operation, proper handling facilities are required for animal control, and allow such activities as velveting, inspection, and sorting. A handling facility would include a holding corral, crowding pens, a squeeze for bison and wapiti, and weigh scales. Further details are available in Renecker and Biewald (1985) although the corral cost is lower than they estimated. A 60 HP tractor equipped with a front end loader is required for tasks such as moving round bales for winter feeding, snow clearing and general maintenance activities.

The facilities in the previous paragraphs are assumed to be adequate to handle up to 1000 animals. Beyond that number an intensified management effort, such as pasture subdivision for greater control over breeding, is required. The facilities must be expanded to handle the larger numbers and simultaneously handle two groups. The expansion is assumed to be 10 km of additional fence, a 25% corral expansion, additional landscaping, and a squeeze.

Annual Costs

The annual costs are summarized in Table IV.5. Fixed costs include maintenance on fixed assets, insurance, property tax, and full time labor. Maintenance on fixed assets (fences and corrals) are assumed at 1% of their value (Andruchow 1982). Property taxes are assumed at $1.40/ha ($90/quarter section) (Leo Reayon, NRS Reality, pers comm). Full time labor (including the manager) is treated as a fixed cost. The estimates of the number of animals that one person can handle vary from 500 to 4,000 (Anderson 1978) with extra assistance at velveting time and round up. This study assumes that one person can handle up to 1,000 animals with an additional full-time person hired for each additional 1,000 animals. The basic yearly wage is assumed to be $20,000 with a $1,000 raise each year for the manager.

TABLE IV.5 SUMMARY OF ANNUAL COSTS

FIXED COSTS	
Maintenance (fences and corrals)	$1,964
Insurance (machinery and buildings)	$254
Property Taxes	$3,068
Full-time Wages (per 1000 animals)	$20,000
VARIABLE COSTS	
Additional Labour (per animal)	$2.50
Velveting Costs (per animal)	$30
Machinery Operating Costs (per animal)	$65.68
Medicine (per animal)	$0.30
plus (per 50kg BW)	$0.52
Hay (per kg fed)	$0.08263
Land Clearing and Seeding (per ha)	$259.56
Marketing	2% of sales

The variable costs consist of the extra labor required at peak periods, veterinary supplies, velveting costs, marketing costs, machinery operating costs and winter feeding costs. Casual labor costs are assumed at $7.50/hr. It is estimated that 2 people plus 1 full time employee can handle 6 animals an hour during the fall round up at a cost of $2.50/animal. Velveting costs are estimated at $30/animal (Renecker and Biewald 1985) including veterinary costs. Medicine costs during round up are estimated at $0.30/animal

(8 Way) plus $0.52/50kgBW (IVOMEC). Machinery use estimates are assumed similar to a cow-calf operation and are 3 hrs/animal for the truck and 5 hrs/animal (Owen, Milligan and Portail 1985) for the tractor at $6.32/hr and $11.51/hr respectively (Andruchow 1982). Marketing costs are assumed to be 2% of sales.

Two other costs are included in the model. Winter feeding, (a variable cost) is based on the average October price of hay (1981-1986) of $.08263/kg with a range of $.06813/kg to $.10247/kg. The cost of clearing land is estimated to be $247/ha for brushing and piling (Alta. Agri. 1987) plus $12.56/ha for seeding (Renecker and Biewald 1985). The amount of hay fed and area cleared per year are generated by the models.

Product Prices

Current expected prices are used to calculate the cost of purchasing the breeding herd and as a starting point for the price trends. The prices were gathered from a mailout questionnaire of current Alberta bison producers, and interviews of bison and wapiti producers at various producer meetings in 1986, along with prices reported in current literature.

Producers were asked to provide their best estimate of low, most likely, and high prices for: bison and wapiti calves, yearlings, two year olds and adults; velvet (grade

A); meat (bison and wapiti); and bison feeders (Table IV.6). A triangular distribution for the prices is assumed. The price differential for velvet grades is assumed to be constant and is taken from Bryan (1986). A4 is the base grade, A1 is 96% of A4, B4 is 94% of A4, B1 is 77% of A4, and C1 is 59% of A4.

The prices collected for live male wapiti created some problems. Some very high prices were given representing premium stud prices. Most producers were unable to provide low and most likely prices. Therefore, the prices used for male wapiti in the models are derived from the equation by Sandrey and Zwart (1986) given earlier with high, likely and low prices based on the respective velvet prices. A second problem relates to meat prices. Prices for young carcasses are unlikely to be the same as for older carcasses. The assumption is made that the venison price applies for animals two years and younger. The meat price for older animals is assumed to be 60% of the venison price which is the approximate price ratio of D1 cows to A1 steers.

As moose are not currently traded, the live price of moose is set at $500, the statutory price for moose provided by the government. No live sale of moose is incorporated in the model.

Discount Rate

TABLE IV.6 PRODUCT PRICES

			Lowest	Most Likely	Highest	Expected
Live Sales ($/animal)						
	Bison	Calf ♂	$450	$700	$1,000	$717
		♀	$450	$738	$1,000	$729
		Yrling ♂	$650	$923	$1,200	$924
		♀	$650	$946	$1,200	$932
		2 Yrs ♂	$800	$1,000	$1,400	$1,067
		♀	$900	$1,150	$1,400	$1,150
		Adult ♂	$1,200	$1,500	$2,000	$1,567
		♀	$1,200	$1,650	$2,000	$1,617
	Wapiti	<2Yrs ♂	$1,200	$2,000	$7,000	$3,400
		♀	$2,000	$3,500	$5,500	$3,667
		2 Yrs ♂	$2,500	$3,000	$6,000	$3,833
		♀	$3,000	$4,000	$8,000	$5,000
		Adult ♂	$2,000	$4,000	$14,000	$6,667
		♀	$2,500	$4,000	$8,000	$4,833
Meat ($/kg dressed)		Bison	$5.50	$6.68	$7.94	$6.71
		Wapiti	$4.31[1]	$5.64[2]	$11.00[3]	$6.98
Bison Feeders		($/kg live)	$1.50	$2.63	$3.50	$2.54
Velvet ($/kg)		Grade A4	$77.00	$110.00	$187.00	$124.67

[1] New Zealand Price
[2] 1.75 X price of A1 steer (R. Alsager pers. comm.)
[3] Fallow deer eastern Canada (Renecker 1987)

The cost of capital is used as the discount rate. To obtain the cost of capital, the capital asset pricing model (CAPM) is used. The risk free interest rate (R_f) and the market risk premium ($RP=k_M-R_f$) are needed to use CAPM. As game ranching is a long term investment, the long term interest rate and market return should be used to calculate RP.

RP is based on the TSE 300 and Canada long term bonds (>10 year) between 1956 and 1986[9]. The market return was calculated from the TSE 300 Total Return Index on 20 year periods. $k_M=9.75\%$, $\sigma_M=1.45$, $CV_m=0.15$. The average yield on long term Canada bonds for 1956 to 1986 was 7.91%. Therefore $RP=1.84$.

The real discount rate is the risk free rate net of inflation. The anticipated rate of inflation, particularly in the long term, is difficult to ascertain making the long term real interest rate difficult to estimate. The real discount rate is therefore calculated from short term interest rates. Brigham and Gapenski (1985) report that the U.S. rate has historically fluctuated in the range of 2% to 4%. Short term (3 month) Treasury Bills are considered riskless and the anticipated short term inflation rate should reflect the current inflation rate. The real rate is then estimated by subtracting the inflation rate (annual CPI% change) from the riskless rate (3 month T-Bill average). The average real interest rate in Canada is estimated to be 4.83% (1981-1986).[18]

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[9] The expected inflation rate must be the same for k_M and R_f.

E. Linear Program

The parameters and relationships used in a game ranching system have been described. A linear program is used to determine the efficient species combination, herd structure and product mix. The model is an annual process model optimizing the system over a year's operation and assumes that the system is in place. The activity set, constraint equations and objective function are described below.

The activity set consists of all species/sex/age classes, products, and winter feeding inputs. Female age classes for all three species are included to 12 years. Male bison are included to 5 years, male wapiti to 12 years, and male moose to 7 years. The products included are velvet, venison, bison feeders (2 years), and live sales for the following bison and wapiti sex/age classes: calf to 3 year females, calf and yearling males. Winter feeding inputs are specified for both wapiti and bison; inputs are either hay or range foraging.

There are three types of constraint equations: resource limits, strategy constraints, and transfer equations. The resource limit equations restrict the animal populations to the forage available. The strategy constraints limit the sex ratios to a maximum number of females to males and allow the selection of supplimental feeding or range foraging for bison and wapiti. The transfer equations pass animals between age classes and account for the probability of surviving the year.

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[18] Source: Statistics Canada

There are two resource limit equations, browse and herbaceous forage. They take the form:

$$R \geq \sum_{sp=1}^{3} \sum_{sx=1}^{2} \sum_{a=0}^{m} \alpha_{sp,sx,a} N_{sp,sx,a} + \sum_{sp=1}^{2} \xi_{sp} W$$

where R, is the total resource available; sp is the species (1=bison, 2=wapiti, 3=moose), sx, the sex; a the age; m, the oldest age class for each species/sex/age class; W, the total amount of forage each species consumed during winter feeding; ξ, the proportion each species consumes of that resource in winter, and α, the amount of each forage group consumed in summer by $N_{sp,sx,a}$.

Transfer equations for passing the animals between age class including equations for births, take the form:

$$\beta_{sp,sx,a-1} N_{sp,sx,a-1} = N_{sp,sx,a} + \beta_{sp,sx,a-1} SN_{sp,sx,a-1}$$

where β is the mortality rate for each age class, and SN is the sale of an animal in each species/sex/age class. The birth equations take the form:

$$N_{sp,sx,calf} = \sum_{a=1}^{m} \gamma_{sp,a} T_{sp} N_{sp,female,a}$$

where γ is the fecundity rate for each age class, and T is the sex ratio at birth. The winter feeding equations allow winter feeding on available range forage or purchased hay. There is an equation for wapiti and one for bison, taking the form:

$$W + .9H = \sum_{sp=1}^{3} \sum_{sx=1}^{2} \sum_{a=0}^{m} \eta_{sp,sx,a} N_{sp,sx,a} - SN_{sp,sx,a}$$

where *H* is hay and η is the amount of forage consumed by *N* in winter.

There are strategic constraint equations that limit the sex ratios for each species. These equations take the form:

$$\sum_{a=l}^{m} N_{sp,male,a} \geq \sum_{a=k}^{m} \rho_{sp} N_{sp,female,a}$$

Where *l* and *k* are the first breeding ages for males and females respectively, and ρ is the mininum proportion of males to females.

There are also balance equations for bison feeders, venison, and velvet. The velvet balance equation balances the amount of velvet sold with velvet produced based on the number of male wapiti 2 years and older. The venison balance equation balances the amount of venison sold with the number of wapiti and moose harvested for venison. The feeder balance equation converts the number of bison feeders sold to a weight basis.

The objective function maximizes the gross margin (GM). It takes the form:

$$GM = p_v V + p_{ven} Ven + p_f \overset{\vartriangle}{F} - p_h H - \sum_{sp=1}^{3} \sum_{sx=1}^{2} \sum_{a=0}^{m} \pi_{sp,sx,a} N_{sp,sx,a} + \sum_{sp=1}^{3} \sum_{sx=1}^{2} \sum_{a=0}^{m} p_L SL_{sp,sx,a}$$

where p_v, is the price of velvet; *V*, the amount of velvet produced; p_{ven}, the price of venison; *Ven*, the amount of venison produced; p_f, the price of bison feeders (per kg); *F*, the total weight of bison feeders; p_h, the price of hay; π, the variable maintenance cost for each species/sex/age class (slaughter value is added for terminal age class); *SL*, live sales; and p_L, the corresponding live sale prices.

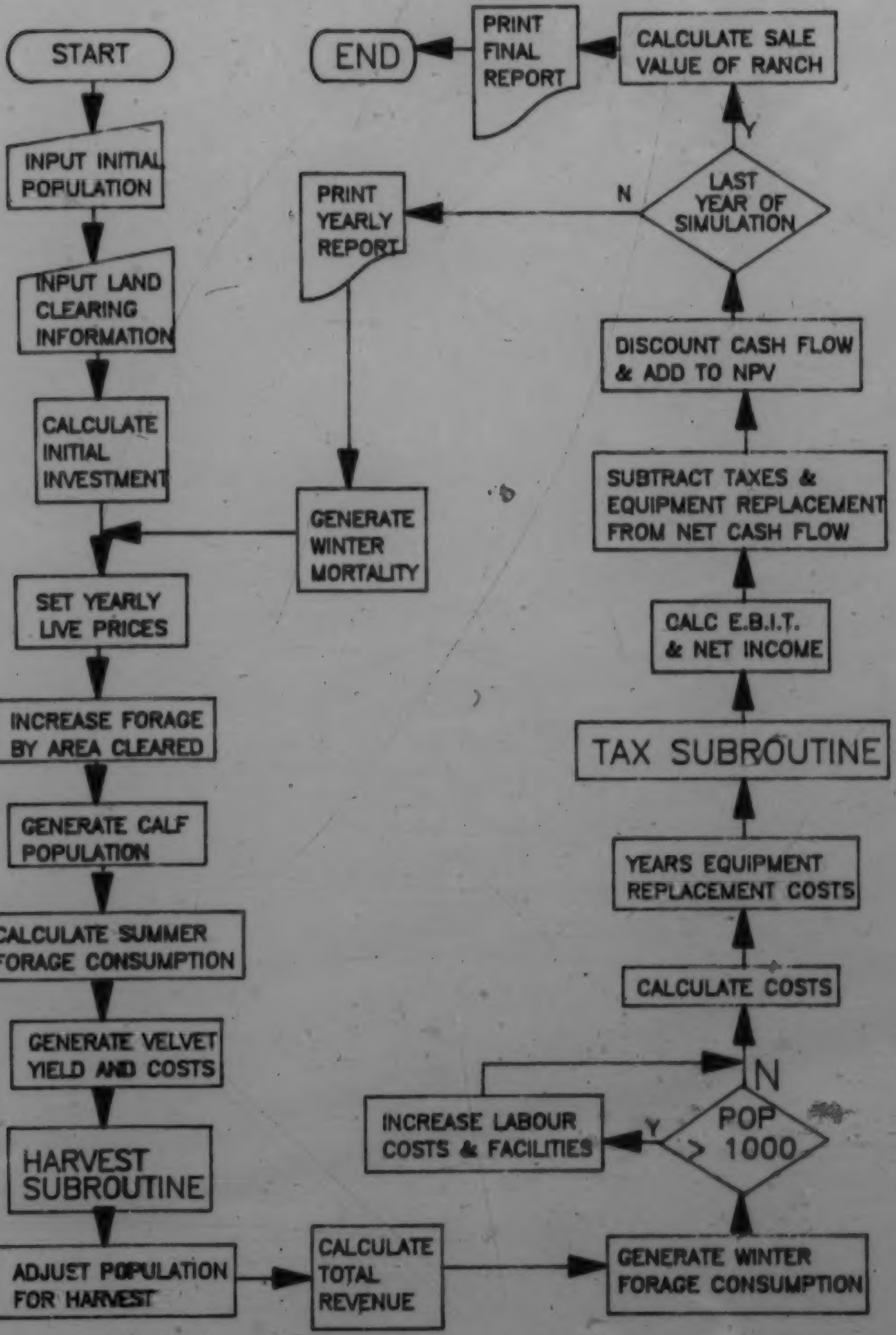
F. Systems Model

The systems model is a computer simulation program that simulates a game ranch operation from the initial investment through a specified number of years and calculates the NPV. The optimum herd structure and product mix generated by the linear program are used as population targets for the model. The user specified inputs to the model are the size of the initial breeding herd, the number of years of operation to simulate, and whether land clearing is to occur (intensive or extensive operation). The base scenario assumes an initial purchased herd of 200 wapiti and six moose. The parameters used in the model have been discussed earlier and are the same as used in the linear program.

The model produces a yearly report containing the population status, input/output summary, income statement, and a cashflow analysis. Income accounting is done on an accrual basis. The final report details the present value cashflows by year, calculates a sale value of the ranch and gives the ranch NPV. The sale value is estimated as the present value of the average of the last five years net income in perpetuity.

The model structure is illustrated in Figure IV.2. The harvest is generated by comparing to the current population to specified target population at the harvest ages. The target population harvest ages and harvest products are input from the linear program. Changes in the product prices result in different target populations, ages and products

FIGURE IV.2 GAME RANCH SIMULATION FLOW CHART


START
INPUT INITIAL POPULATION
INPUT LAND CLEARING INFORMATION
CALCULATE INITIAL INVESTMENT
SET YEARLY LIVE PRICES
INCREASE FORAGE BY AREA CLEARED
GENERATE CALF POPULATION
CALCULATE SUMMER FORAGE CONSUMPTION
GENERATE VELVET YIELD AND COSTS
HARVEST SUBROUTINE
ADJUST POPULATION FOR HARVEST
CALCULATE TOTAL REVENUE
GENERATE WINTER FORAGE CONSUMPTION
POP > 1000
Y
INCREASE LABOUR COSTS & FACILITIES
N
CALCULATE COSTS
YEARS EQUIPMENT REPLACEMENT COSTS
TAX SUBROUTINE
CALC E.B.I.T. & NET INCOME
SUBTRACT TAXES & EQUIPMENT REPLACEMENT FROM NET CASH FLOW
DISCOUNT CASH FLOW & ADD TO NPV
LAST YEAR OF SIMULATION
Y
CALCULATE SALE VALUE OF RANCH
PRINT FINAL REPORT
END
N
PRINT YEARLY REPORT
GENERATE WINTER MORTALITY

being used.

The tax subroutine is based on the tax regulations for 1985. Accounting for income tax is done on a cash basis. It is assumed the ranch is structured as a Canadian controlled private corporation and therefore corporate tax rates apply. It is also assumed that the initial financing is equity financed (preferred shares) and therefore no debts (before tax interest to pay). Any positive cashflow is assumed to be paid to the shareholders as dividends and Part II taxes apply.

The sale (market value) of the ranch in the last year of simulation is based on the ranch's productive value. The sale value is calculated as the present value in perpetuity of the average net income over the last five years of simulation. Therefore the simulation must run until the production is based on venison sales (breeding prices have stopped falling) and the herd size has stabilized. After this point, the simulation period will not alter the result.

G. Monte Carlo Simulation

Uncertainity exists in the values for both prices and biological parameters. Probability distributions for each were previously described. Two types of parameter uncertainity exist; some parameters are likely to vary from year to year, while others are likely to be consistent but are not known with certainity. The Monte Carlo simulation goes through 40 year runs of ranch operation varying the parameter values, and calculates the mean NPV and standard deviation. The random number generator and cummulative probability distribution function are used to select the parameter value.

The biological parameters: fecundity, mortality, velvet yield and body weight are likely to vary greatly between individual animals. However, the herd mean is not thought to vary greatly from year to year given the same level of management. The uncertainity is in the mean paramenter value. The biological parameters above are varied for each 40 year iteration. The prices for meat and hay are likely to vary from year to year. The model generates a new value for each year, independance between years is assumed.

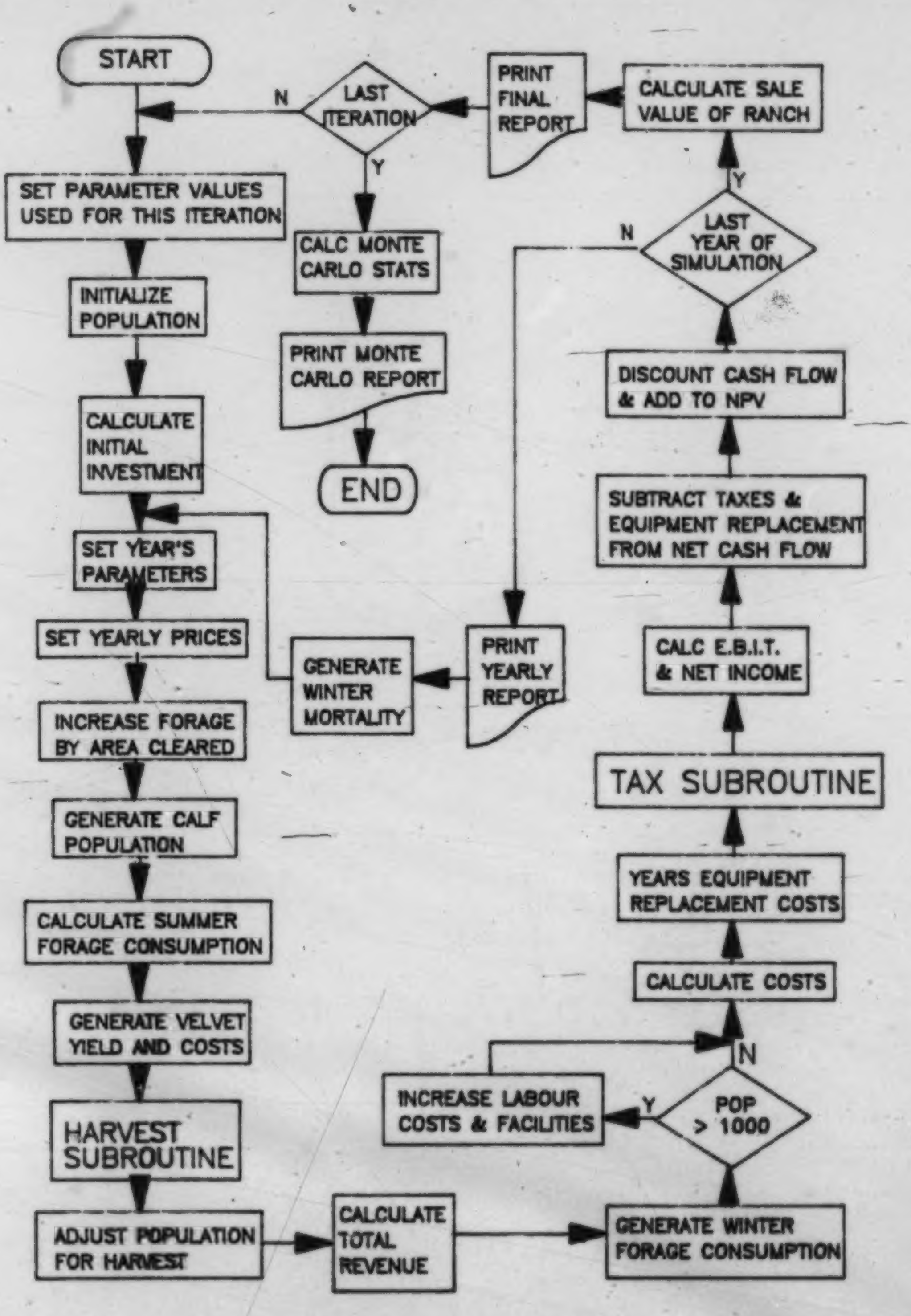
Breeding stock and velvet prices are likely to vary from year to year from the trend described earlier but the year to year prices are not likely to be independent. This makes simulation difficult. To simplify the simulation, the price in year zero is varied and the same trend assumed from that initial price.

Figure IV.3 is the flow chart for the Monte Carlo simulation.

H. Summary

The early part of this chapter contains the physical, biological and economic relationships and parameters used in this analysis. A model is used to generate male wapiti prices based on present value of their velvet and venison

FIGURE IV.3 GAME RANCH MONTE CARLO SIMULATION FLOW CHART


START
N
LAST ITERATION
Y
PRINT FINAL REPORT
CALCULATE SALE VALUE OF RANCH
SET PARAMETER VALUES USED FOR THIS ITERATION
CALC MONTE CARLO STATS
Y
N
LAST YEAR OF SIMULATION
INITIALIZE POPULATION
PRINT MONTE CARLO REPORT
DISCOUNT CASH FLOW & ADD TO NPV
CALCULATE INITIAL INVESTMENT
END
SUBTRACT TAXES & EQUIPMENT REPLACEMENT FROM NET CASH FLOW
SET YEAR'S PARAMETERS
SET YEARLY PRICES
GENERATE WINTER MORTALITY
PRINT YEARLY REPORT
CALC E.B.I.T. & NET INCOME
INCREASE FORAGE BY AREA CLEARED
TAX SUBROUTINE
GENERATE CALF POPULATION
YEARS EQUIPMENT REPLACEMENT COSTS
CALCULATE SUMMER FORAGE CONSUMPTION
CALCULATE COSTS
GENERATE VELVET YIELD AND COSTS
N
INCREASE LABOUR COSTS & FACILITIES
Y
POP > 1000
HARVEST SUBROUTINE
ADJUST POPULATION FOR HARVEST
CALCULATE TOTAL REVENUE
GENERATE WINTER FORAGE CONSUMPTION

production. A likely trend for future product prices is postulated.

Linear programming is used to derive the efficient ranch structure at various product price levels. A systems model simulates the operation of the ranch generating the cash flows from establishment to maturity. A Monte Carlo simulation of the systems model is first run to determine the cash flow variation (discounting by the riskless discount rate). CAPM is then used to calculate the risk adjusted discount rate. By using the risk adjusted discount rate in the systems model, the expected NPV is derived. Varying different assumptions about the likely future price trend, gives a sensitivity analysis of the expected NPV to future prices.

V. RESULTS AND DISCUSSION

A. Male Wapiti Pricing

A model to calculate the NPV of weaned male wapiti was constructed based on the equation by Sandry and Zwart (1986) in Chapter IV. The biological parameters listed in Chapter IV were used except that the productive lifespan was assumed to be 15 years[11] with the mortality rate increasing by 1% for every year after 12 and the velvet yield in years 13, 14, and 15 being equal to the 8, 7, and 6 year old yields respectively. The discount rate is assumed to be 10% (a 5% risk premium). The costs used in these calculations do not include an opportunity cost for pasture or returns to management.

The optimum age to slaughter males occurs when the costs of keeping the male one more year is greater than the revenue from velvet plus the change in slaughter value. Table V.1 shows the NPV of slaughtering males at different ages. The lower venison value for three year olds is reflected by the drop in NPV as the slaughter age increases from two to three. At current velvet and venison prices, males should be slaughtered when they are 15 years of age (the maximum age permitted in the model). With better data on velvet yield and mortality rates for older animals, a

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[11] A longer lifespan is used to illustrate the effect of decreasing velvet yields on optimal slaughter age. However, the older animals would be nonbreeding and little biological data exists for these ages. The difference in NPV between slaughtering at 12 years and 15 years is minimal.

TABLE V.1 NPV OF SLAUGHTERING MALE WAPITI AT DIFFERENT AGES

Kill Age (Years)	Meat Value ($)	Velvet Wt[1] (Kg)	Velvet Value[1] ($)	Cost[2] ($)	NPV[3] ($)
0.5	403	0.00	0	70	333
1.5	847	0.00	0	97	585
2.5	1131	2.93	354	157	858
3.5	893	3.67	361	176	713
4.5	972	4.04	434	188	825
5.5	1022	5.14	507	196	937
6.5	1054	5.88	580	201	1053
7.5	1075	6.62	653	204	1175
8.5	1088	7.36	726	206	1302
9.5	1096	8.10	799	207	1431
10.5	1102	8.84	872	208	1562
11.5	1105	8.84	872	209	1675
12.5	1107	8.10	799	209	1759
13.5	1109	7.36	726	209	1817
14.5	1109	6.62	653	209	1854
15.5	1110	5.88	580	209	1874

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[1] Velvet produced in that year.
[2] Production cost in last year including feeding.
[3] NPV of weaner male slaughtered at each age.

less arbitrary terminal age could be identified, that is an optimal age determined.

When the price of velvet decreases, the marginal revenue from keeping a male one more year decreases as velvet prices decrease. Table V.2 shows the velvet prices at which the slaughter age decreases for a range of venison prices. At the expected venison price ($6.98/kg), the slaughter age drops to 14 years when velvet is $88/kg and to two years when velvet is $75/kg. The drop from 14 to two years is caused by the drop in carcass value after two years. The same venison price for all ages would cause a year by year decrease in the slaughter age. The slaughter age drops to one year only in the case of low venison prices and very low velvet prices.

The price for various aged males is the NPV of future benefits minus the costs times the probability of surviving. Table V.3 lists male prices for high, most likely, low and expected velvet prices. The animals are assumed to be sold in the fall. The terminal value is the slaughter value. The NPV based prices for velvet at $110/kg corresponds roughly to the low male prices received in the questionnaire (Table IV.6) except for calves and yearlings. The most likely calf and yearling price corresponds to the NPV based price.

The observed prices would seem to indicate that calves and yearlings are rationally priced based on the expected velvet production. Older male prices reflect premium stud prices with only the lower observed prices based on velvet

TABLE V.2 VELVET PRICES AT WHICH THE SLAUGHTER AGE DECREASES FOR THE RANGE OF VENISON PRICES

	Venison Price ($/Kg)			
	11.00 Highest	5.65 Most Likely	4.31 Lowest	6.98 Expected
Age'	Threshold Velvet Price ($/Kg)			
14	113	80	71	88
13	96	--	--	-
2	95	68	62	75
1	--	9	20	-

'New slaughter age.

TABLE V.3 LIVE MALE WAPITI PRICES SLAUGHTERED AT THE OPTIMUM AGE FOR THE RANGE OF VELVET PRICES

	Velvet Price ($/Kg)			
	187 Highest	110 Most Likely	77 Lowest	125 Expected
Age	Male Live Prices ($)			
0.5	3377	1606	854	1951
1.5	3967	1938	1075	2333
2.5	4172	2065	1171	2475
3.5	4414	2223	1294	2650
4.5	4594	2352	1403	2789
5.5	4699	2443	1490	2883
6.5	4715	2489	1549	2922
7.5	4627	2479	1576	2898
8.5	4418	2406	1563	2798
9.5	4072	2260	1505	2613
10.5	3566	2028	1394	2328
11.5	2987	1763	1268	2002
12.5	2433	1525	1169	1702
13.5	1938	1334	1114	1452
14.5	1497	1194	1109	1253
15.5	1110	1110		1110

production. Sandrey and Zwart (1986) found that the observed New Zealand prices were lower the the NPV based prices and that the observed price was equivalent to including a high risk premium (25%) in the discount rate.

B. Optimal Ranch Structure

The optimal ranch structure is derived through the use of linear programming. The solution is a function of input and output prices. Therefore, changes in prices will change the solution. The optimal ranch structure under current prices and the manner in which the structure changes with price changes is detailed in this section. The animal populations are constrained by the forage resources available. The herd structure is limited by the sex ratio, mortality, and fecundity rate.

Resource Partitioning and Species Selection

The forage resources are the ultimate constraining factor limiting the size of the population and thus the amount of products produced. The linear program allocates the resources to the species with the highest marginal value product (MVP). Bison and wapiti are in direct competition for the herbaceous forage. Wapiti are selected and bison excluded by the model due to the higher MVP of wapiti for herbaceous forage. Moose are included in the solution to use the available browse resource.

In winter, wapiti can either be fed hay or forage on the range. Feeding the wapiti in winter is a method of increasing the carrying capacity as all the herbaceous forage can be consumed in summer. Winter feeding will occur as long as the MFC of hay is less than the opportunity cost of having wapiti forage on the range. Hay can increase to \$.53/kg before this occurs, which is five times the highest price of hay. Although not permitted in the linear program, browse could be substituted for up to 40% of the hay if the MFC_{browse} is less than the MFC_{hay}. Browse does not cost anything to produce, but has an opportunity cost from moose production forgone, which is a shadow price (MFC). The MVP for moose production (\$.60/kg) is greater than the MFC of hay (\$.0826/kg), thus browse is used for moose production. The opportunity cost of having wapiti forage in winter is \$.45/kg of hay reduced.

The MVP of each forage resource (the increase to the gross margin by increasing the forage by 1 kg) is \$.60/kg for browse and \$.76/kg for herbaceous forage. Land clearing in which browse is reduced by 4.8 kg/ha and herbaceous forage increased by 1,383 kg/ha, is included in the solution to the maximum 1,205 ha. The opportunity cost of not clearing land is \$990/ha. Land clearing has the effect of reducing the moose population while increasing the wapiti population.

Structure under Present Prices

The wapiti herd structure under current prices is shown as Scenario A in Table V.4. As wapiti are the primary species, the following discussion refers to wapiti unless otherwise noted. The production strategy is to produce primarily female breeding stock with males sold as calves. Female breeding stock is sold at 3 years and a core breeding herd is kept until 12 years. However three years old is the maximum age for live sales permitted in the model. If older female live sales at the same price were included in the model, the solution would include sales of the oldest age class. The harvest strategy of partial harvest of one age class and complete harvest of an older age class is similar to optimal harvest patterns found in other studies (Beddington and Taylor 1973).

The shadow prices[12] for female two year olds, yearlings and calves are $5325, $5093, and $3840 respectively (3 year old_female price is $4833). As prices are the medium of information between buyer and seller, a preferred age will emerge with the prices for older ages based on the preferred price (the shadow prices). Producers will want to keep females as long as possible before selling while buyers will want the females young but of a producing age. Thus the three year age class in the model is not unrealistic as a preferred sale age.

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[12] The price for that product to be included in the solution.

TABLE V.4 OPTIMAL WAPITI HERD STRUCTURES (LINEAR PROGRAM SOLUTION)

Sex/Age Class		Scenario			
	A	B	C	D	E
	(Number of Animals)				
calf ♂	304.8	55.8	80.9	218.6	258.9
♀	304.8	55.8	80.9	218.6	258.9
1 Yr ♂	4.2	0.8	76.3	206.1	244.1
♀	287.5	52.6	76.3	206.1	244.1
2 Yr ♂	4.0	0.7	73.3	197.9	2.7
♀	276.0	50.5	73.3	197.9	234.4
3 Yr ♂	3.8	0.7	70.3	2.2	2.6
♀	264.9	48.5	17.0	45.8	54.3
4 Yr ♂	3.7	0.7	67.5	2.1	2.5
♀	35.2	6.4	16.3	44.0	52.1
5 Yr ♂	3.5	0.6	64.8	2.0	2.4
♀	33.8	6.2	15.6	42.2	50.0
6 Yr ♂	3.4	0.6	62.2	1.9	2.3
♀	32.5	5.9	15.0	40.6	48.0
7 Yr ♂	3.3	0.6	59.7	1.8	2.2
♀	31.2	5.7	14.4	38.9	46.1
8 Yr ♂	3.1	0.6	57.3	1.8	2.1
♀	29.9	5.5	13.8	37.4	44.3
9 Yr ♂	3.0	0.5	55.1	1.7	2.0
♀	28.7	5.3	13.3	35.9	42.5
10 Yr ♂	2.9	0.5	52.8	1.6	1.9
♀	27.6	5.0	12.7	34.5	40.8
11 Yr ♂	2.8	0.5	50.7	1.6	1.8
♀	26.5	4.8	12.2	33.1	39.2
12 Yr ♂	2.7	0.5	48.7	1.5	1.8
♀	25.4	4.6	11.7	31.7	37.6

Scenario A - Present Prices
Scenario B - No Land Clearing
Scenario C - Velvet Ranch
Scenario D - Velvet/Venison Ranch
Scenario E - Venison Ranch

TABLE V.4 continued

Sex/Age Class	A	B	C	D	E
Sell Calf ♂	300.4	55.0	0.0	0.0	0.0
Sell Calf ♀	0.0	0.0	0.0	0.0	0.0
Sell 1 Yr ♂	0.0	0.0	0.0	0.0	*243.1
Sell 1 Yr ♀	0.0	0.0	0.0	0.0	0.0
Sell 2 Yr ♂	0.0	0.0	0.0	*195.6	0.0
Sell 2 Yr ♀	0.0	0.0	*55.6	*150.1	*177.8
Sell 3 Yr ♀	228.2	41.8	0.0	0.0	0.0

* Slaughtered

The solution is insensitive to male prices. Keeping males older than calves (except for the breeding herd) uses resources required for female production and represents a large opportunity cost. The price for males calves would have to drop to $1390 from $2007 before yearling males are sold. Conversely the shadow prices for male yearlings and two year olds of $3158 and $4343 respectively are much greater than the animals NPV. These shadow prices are indicative of the opportunity cost in a resource constrained situation. If a ranch is not resource constrained (a ranch just being established), then males can be retained to an older age for velvet production if calf prices drop.

High breeding prices for females result in the herd structure being insensitive to changes in velvet and venison prices. The venison price would have to rise to $26/kg for males to be slaughtered as yearlings for meat. Conversely slaughtering male and female yearlings would incur opportunity costs of $2310 and $4248 respectively. Not until female live prices drop, do velvet and venison become important products.

The implicit assumption in this ranch structure is that there is a market for male calves. At the current velvet prices there is the opportunity for specialist velvet ranches (male only herds) to establish that buy males as calves. Breeding stock ranches will sell male calves below the NPV price while female prices are high, providing the opportunity for velvet ranches to capture some of the NPV. Failing a market for live male calves, a slaughter (or feeder) market for male calves could establish.

The moose herd structure is contained in Table V.5. The structure does not change in any of the scenarios except when land clearing is not permitted. Moose are slaughtered as yearlings. The opportunity costs of harvesting males as calves is $33.55 and for harvesting females as calves or two year olds are $185.17 and $144.12 respectively. A market for moose breeding stock would change this structure to one probably resembling the wapiti structure.

Scenario B (Table V.4 and V.5) gives the structure for the ranch when no land clearing is permitted. This structure would resemble an extensive operation. The harvest age classes are the same as when the land is cleared, the difference being the moose population is larger and the wapiti population smaller. The difference in gross margin between clearing and not clearing land is $1,192,950,

TABLE V.5 OPTIMAL MOOSE HERD STRUCTURE (LINEAR PROGRAM SOLUTION)

Age	Land Cleared Male	Land Cleared Female	No Land Cleared Male	No Land Cleared Female
	(Number of Animals in Each Age Class)			
Calf	11.0	9.0	15.7	12.8
1	7.2	5.9	10.2	8.3
2	0.5	2.5	0.7	3.5
3	0.4	2.3	0.6	3.2
4	0.4	2.1	0.5	3.0
5	0.4	1.9	0.5	2.7
6	0.3	1.8	0.5	2.5
7	0.3	1.6	0.4	2.2
8		1.4		2.0
9		1.2		1.8
10		1.1		1.6
11		1.0		1.4
12		0.9		1.2
Sell 1 Yr	6.7	3.2	9.5	4.5

illustrating the rationality of clearing land.

Future Price Changes

The effect of price changes on the linear program solution for the different groups of products is investigated. The prices used in Scenario A are characteristic of an expanding industry when ranches are being established and a shortage of breeding stock exist. This condition can not last and animal prices must decrease to where they are based on the products produced from them. The following section examines the effect on the solution of price changes.

While the live price of male calves reflects the NPV of the calf from the velvet and venison, males will continue to be sold as calves regardless of the female price. The producer captures the male value through calf sale. However if the live price of males drops below the NPV based price[13] when female prices decline, the relative importance of males to the solution increases. The structure is then very sensitive to the price of velvet. The structure can take the form of Scenario C (the velvet ranch), D (the velvet/venison ranch), or E (the venison ranch) depending on the velvet price.

The earlier section on male pricing showed that the value of velvet production from males is greater than the slaughter value at current velvet prices. If live prices for males and females decreased to reflect slaughter value while velvet remains at current prices, then the velvet ranch structure (Scenario C Table V.4) is optimal. Males would trade for the shadow prices which are $877, $1231 and $1359 for calves, yearlings and two year olds respectively. The female calf shadow price is $575. This structure persists until velvet prices drop below $108.43/kg or venison rises above $7.94/kg.

The velvet ranch structure is radically different from the other herd structures in that the structure is orientated towards males with only sufficient females to produce replacement males. The option of purchasing relacement males was not included in the model. The velvet ranch may be easy to establish initially as primarily readily available males need to be purchased. There is a degree of risk involved as the structure is sensitive to velvet and venison prices. If velvet prices drop or vension prices rise, a major herd restructuring is required. Females must be purchased and the value of male inventory would be drastically reduced causing a large net income loss.

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[13] This could occur if specialist velvet ranches do not establish and causes an over supply of male calves.

A far more probable situation is for velvet prices to have decreased below $108.43/kg by the time female prices have a declined to slaughter based prices. The velvet/venison ranch structure (Scenario D Table V.4) is then the optimal structure. This structure produces significant quantities of both velvet and venison by slaughtering two year olds. The transition from a breeding ranch to the velvet/venison ranch occurs when the value of retaining a male to two years is greater than the opportunity cost of selling it as a calf in order to produce more females. The relative prices of males, females and velvet determines when this will happen. A parametric programming run following the price trends assumed in the simulation model showed that the switch occurs when female prices approach slaughter value (female 2 year olds - $1008, male calf - $644, velvet - $75/kg).

The velvet/venison ranch structure is stable for a wide range of velvet and venison prices and is therefore the most probable structure once female live prices reflect slaughter value. Velvet prices can range between $108.43/kg and $34.68/kg with the structure remaining stable. The difference between the velvet price range for slaughtering two year olds given by the linear program (34.68 - 108.43 $/kg) and the NPV model (0 - 76 $/kg [Table V.2]) is that the NPV model does not include the opportunity cost of forgone male and female production in a resource constrained situation.

The shadow prices for male calves, and yearlings when velvet is $100/kg, are $685 and $992 respectively. The shadow prices for female calves and yearlings are $618 and $908 respectively. If one assumes the cost structure of the ranch is representitive of the industry, then these shadow prices should be reflected in the market as the long run equilibrium prices. The opportunity cost of slaughtering males and females as yearlings is $144 and $114 respectively.

The venison ranch structure (Scenario E, Table V.4) in which males are slaughtered as yearlings will only occur at low velvet prices (below $34.68/kg). Velvet is unlikely to reach this price. However, if the assumption that two year-olds will fetch premium venison prices does not hold true, the threshold velvet price will be much higher.

The venison ranch (velvet price assumed $30/kg) shadow prices for male and female calves are $576 and $646 respectively. The shadow price for female three year olds is $971. Hay would have to increase to $.12297/kg before winter feeding would be reduced. Land clearing costs would have to rise to $156/ha before being discontinued. However, land clearing is an annual cost and the current annual cost of clearing land is $65/ha for a five year ammortization. Winter feeding and land clearing therefore make sense even under the low prices of venison production.

C. Game Ranch Simulation

The linear program gives the optimal solution for a static setting. The simulation model allows an analysis of the movement towards the optimal solution. In particular, the model allows an investment analysis by generating a total budget with cash flows and income statements. The simulation model is not an optimizing model (unlike the linear program) but simulates a predetermined operating pattern.

The harvest subroutine for the simulation model is based on the linear program results. Scenario A in Table V.4 is the target herd structure at initial prices. This herd structure holds until male calf prices go below $643 when the velvet/venison herd structure (Scenario D in Table V.4) becomes the target herd structure. The linear program calls for all but 4.4 male calves and 36.7 female three year olds to be harvested during high breeding prices. The harvest subroutine approximates this result by harvesting all but 4 males and 37 females in odd years, and harvesting 5 males and 36 females in even years. When the male calf price drops below $643, the model harvests all but 2 male two year olds for slaughter and 48 two year old females for live sale or slaughter depending on which price is higher.

An important variable is the simulation period. The terminal sale value of the ranch is the present value of the average net income in perpetuity of the last five years of simulation. For this assumption to be valid the ranch must have reached the optimal structure and live prices must be based on slaughter values. Under the base price scenario[14], the herd structure switches to the velvet/venison structure in year 16 with herd adjustment complete by year 33. Velvet reaches the floor price ($55) by year 38. Due to increasing labour costs[15] and alternating moose harvest, the net income never completely stabilizes. Year 40 is picked as the last year of the simulation. The base scenario net income varies between $132,036 and $128,911 in years 36 to 40.

The linear program indicates that land clearing should occur but it does not deal with the timing of the clearing. The simulation model allows clearing to occur in equal blocks starting in any year over any number of years. The optimal timing for clearing occurs when the marginal benefit from clearing each additional hectare a year earlier (through decreased feed costs[16]) equals the marginal cost of clearing one hectare a year earlier. The optimal clearing sequence was determined through trial runs (solutions that caused over grazing were excluded). For an initial population of 200 wapiti and 6 moose, the highest NPV (at a 10% discount rate) results from land clearing started in year zero and clearing 120.5 ha/year for 10 years.

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[14] Female prices increase 15% for the last five years and then decline 10% annually. The initial herd is 200 wapiti and 6 moose.

[15] Manager's raise.

[16] Winter feed is calculated as the deficit between forage required and forage availabile. Clearing increases the forage available.

Required Rate of Return

The Monte Carlo simulation generates the NPV probability distribution based on the uncertainty of the various parameter values. The riskless discount rate (R_f) used, represents the time value of money. Table V.6 contains the results of the Monte Carlo simulation on the base scenario for 100 forty year iterations. The mean NPV discounting by R_f is $2,614,308 with a standard deviation of $1,162,452 giving a coefficient of variation of .4446. The simulation model using expected parameter values and R_f gives a NPV of $2,709,150 which is not significantly different (t=0.8159) from the Monte Carlo mean.

The early cash flows are the most variable which causes the CV to increase with the discount rate. The variation generated by the Monte Carlo simulation is greater than would occur in reality due to the structure of the model. The harvest procedure is fixed and is based on expected values. Subsequently, when above or below average biological parameters cause higher or lower rates of population increase, the model under or over harvests respectively. Whereas in reality, a ranch could adjust its herd and harvest structure to match the observed parameters.

TABLE V.6 MONTE CARLO SIMULATION RESULTS

Discount Rate	Mean NPV	St. Dev.	Low NPV	High NPV
0.0483	$2,614,308	$1,162,452	$48,513	$6,732,946
0.0583	$1,945,225	$993,622	$-231,484	$5,436,110
0.0683	$1,445,453	$862,450	$-440,487	$4,452,418
0.0783	$1,055,222	$756,327	$-597,249	$3,674,545
0.0883	$740,896	$668,234	$-718,770	$3,041,514
0.0983	$481,863	$593,834	$-815,334	$2,515,528
0.1083	$264,648	$530,225	$-893,561	$2,071,567
0.1183	$79,990	$475,359	$-957,922	$1,692,207
0.1283	$-78,738	$427,719	$-1,011,550	$1,364,817
0.1383	$-216,432	$386,150	$-1,056,715	$1,079,947
0.1483	$-336,806	$349,747	$-1,095,099	$830,341

The risk adjusted discount rate is the cost of capital, that is the return one could receive on the investment capital if it were invested in some other equally risky venture. CAPM is used to derive the required rate of return (the cost of the capital). Substituting the Monte Carlo results into the security market line:

$$k_i = R_f + \beta_i(RP)$$

$$k_i = 4.83 + (.4446/.15)\ 1.84$$

$$k_i = 10.3$$

This approach is appropriate as it accounts for both the ranchers opportunity cost of capital and the required rate of return by outside diversified investors.

The expected IRR is approximately 12%[17] (between 11.83% and 12.83%). It is interesting to note that the coefficient of variation increases from .44 at 4.83% to 5.94 at 11.83%. There exists the possibility of a negative NPV at discount rates higher than 5%.

The Base Scenario

The simulation model yearly reports detailing the population status, income statement and cash flow for the base scenario are found in Appendix 1 along with the final report summarizing cash flow and net present value. Net cash flow is the sales minus cash costs. Cash costs increase with the herd size showing major variations only in those years of major equipment replacement such as the fence in year 30. Sales however, while a function of herd size, are also a function of product prices (Figure V.1). The change in live prices together with the resulting change in herd structure and products harvested result in the sales depicted in Figure V.1.

The value of live sales (breeding stock) increases for the first eleven years as the herd increases, but as the herd growth slows, the price decrease predominates and the value of live sales drops. In year 16 the harvest regime changes and two age classes of females are harvested resulting in large revenues that year. Up to year 16, the small venison output is from moose and old culls, but

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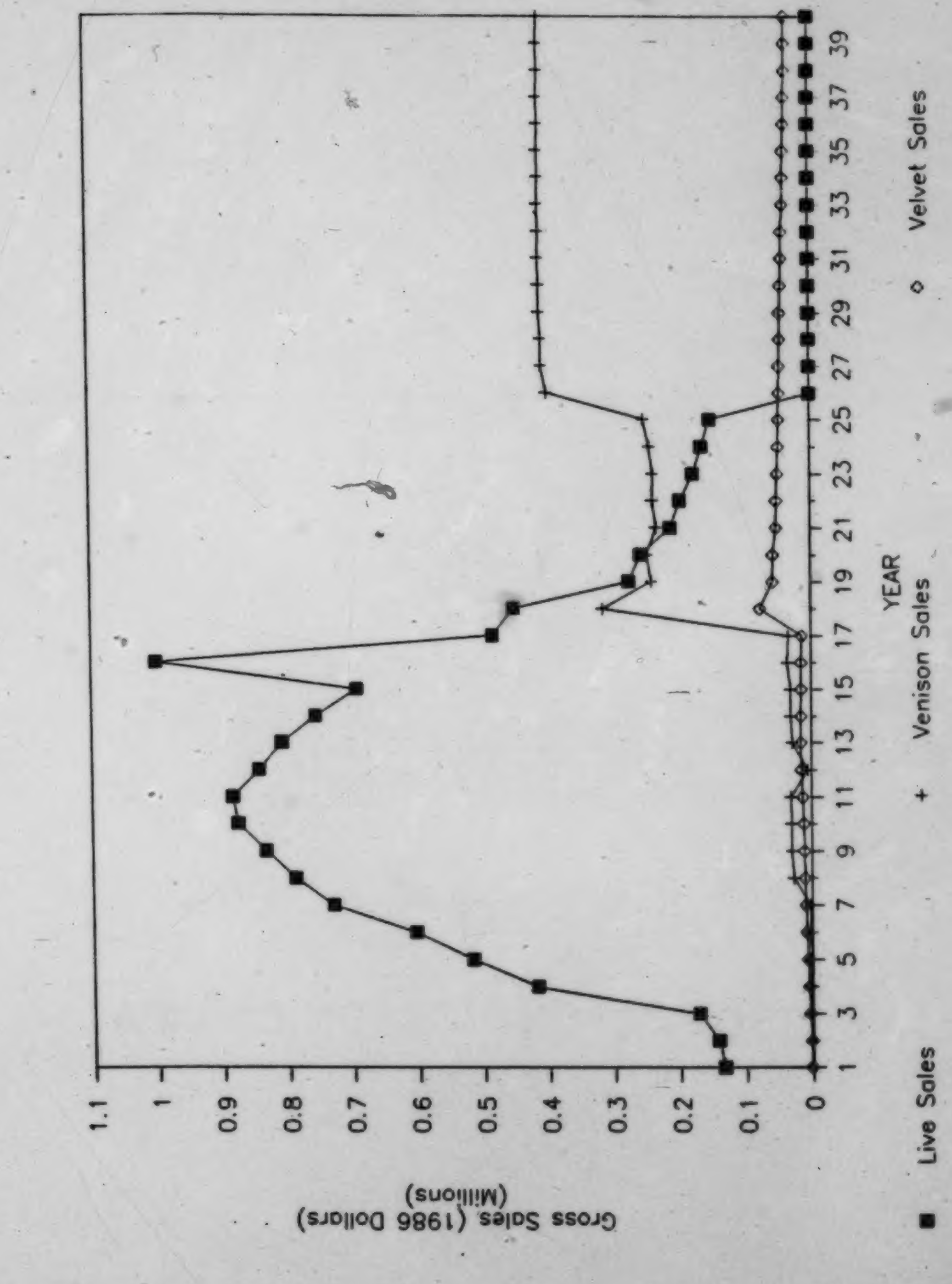
[17] This is a real rate of return

FIGURE V.1 GROSS PRODUCT SALES



starting in year 17, male wapiti are slaughtered. The live sales between years 17 and 25 are female wapiti, in year 25 a~~ll~~ wapiti harvested are slaughtered. Velvet sales become significant in year 18 after the herd structure has changed.

The income statement summarizes each year's operation with the net income reflecting the year's profit. The income statement is useful for analysing the sources of revenue and expenditures. However, the income statement does not give a complete picture as gains and losses are not always realized in that year (inventory adjustment and depreciation). For this reason a cash flow analysis is required to identify cash requirements and to see when gains and losses actually occur. The NPV investment criteria is the sum of discounted cash flows. A cash flow analysis can identify serious short term problems or areas of concern that may not be indicated by income statements or a positive NPV.

Net income, net cash flow (NCF) and NPV are listed by year in Table V.7 with net income and NCF compared in Figure V.2. The rapid increase in net income in the first five years is due to the effect of accrual accounting on a rapid herd build up and price increase. The effect of the subsequent price decrease is greater than the herd increase on inventory valuation and causes the decline in net income. NCF on the other hand, follows sales. The continual inventory value decrease until year 33 causes the divergence of net income and NCF. In year 16 the large female live sale

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TABLE V.7 BASE SCENARIO[*] INCOME, CASH FLOW AND PRESENT VALUE

Year	Net Income	Net Cash Flow	Net Present Value
1	$329,245	$41,537	$-1,662,492
2	$479,965	$42,470	$-1,827,577
3	$778,730	$56,946	$-1,585,130
4	$1,020,401	$200,253	$-1,449,787
5	$1,285,769	$242,556	$-1,301,149
6	$420,896	$278,792	$-1,146,244
7	$387,953	$320,264	$-984,899
8	$226,985	$371,379	$-815,259
9	$218,304	$392,661	$-652,636
10	$166,913	$405,805	$-500,243
11	$119,205	$431,277	$-353,398
12	$181,089	$328,632	$-251,942
13	$113,949	$380,658	$-145,389
14	$85,763	$339,048	$-59,338
15	$84,986	$317,268	$13,672
16	$-116,872	$463,312	$110,343
17	$60,642	$203,391	$148,821
18	$12,924	$344,077	$207,842
19	$60,268	$222,093	$242,384
20	$63,536	$191,235	$269,352
21	$82,111	$174,006	$291,601
22	$74,281	$179,420	$312,401
23	$76,047	$166,444	$329,897
24	$72,772	$159,181	$345,069
25	$75,398	$132,998	$356,562
26	$89,400	$151,301	$368,417
27	$99,304	$152,606	$379,258
28	$107,880	$139,759	$388,261
29	$117,676	$152,527	$397,169
30	$149,958	$-26,240	$395,780
31	$132,063	$155,622	$403,252
32	$133,128	$152,836	$409,906
33	$137,853	$151,377	$415,881
34	$135,467	$149,063	$421,216
35	$135,914	$134,455	$425,580
36	$132,036	$145,646	$429,865
37	$130,962	$144,507	$433,720
38	$129,285	$142,898	$437,177
39	$128,911	$142,457	$440,301
40	$131,780	$117,324	$442,635

[*] Female prices increase 15%/yr for 5 years then decrease 10%/yr to slaughter value.

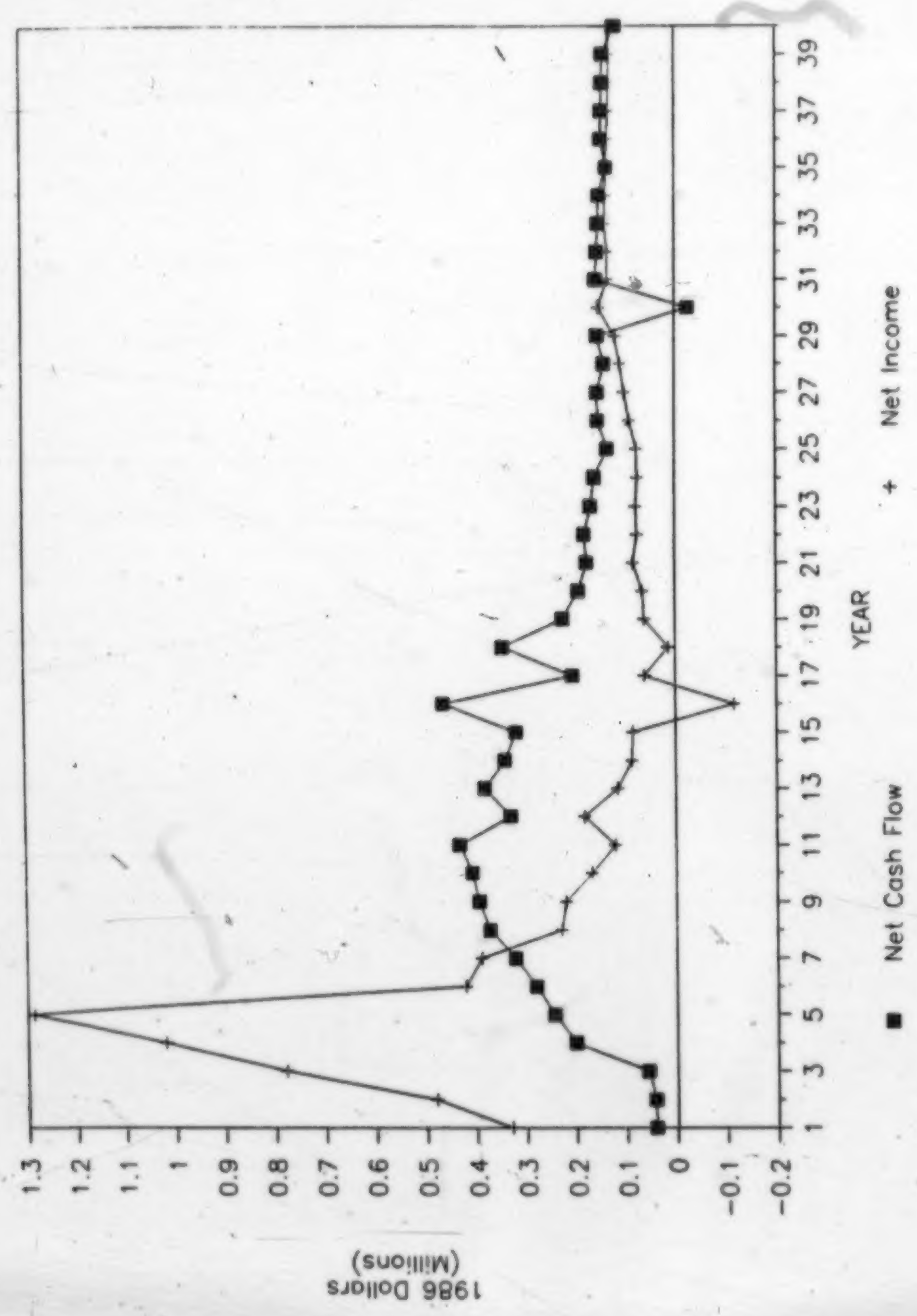
causes the increase in NCF but the tax on the sale[**] causes the net income to be negative. The negative NCF in year 30 is caused by fence replacement. After year 35 when prices and the herd structure have stabilized, the NCF is slightly greater than net income except in years of equipment replacement because depreciation is included in net income.

[**] Tax is on a cash basis.

A comparison of the net income and NCF (Figure V.2) shows the danger of making decisions based on net income using accrual accounting when livestock prices are expected to change significantly. The fantastic net incomes in early years when prices are rising may draw new investors into the industry. In these years the income is derived from inventory appreciation with little coming from sales. Conversely, when prices are falling the reduced net income would result in a more negative view of business than the underlying sales would warrant. This false assumption reinforces the need to view cash flows as the basis for investment analysis.

In figure V.2, one can speculate at the effect of accrual based taxation versus cash based taxation. Accrual accounting for taxation would cause large tax assessments in the early years when insufficient cash is generated to pay the tax. The unrealized income generated in the first years is also greater than the small business deduction limit of $200,000 causing a higher tax rate. The subsequent tax savings through inventory depreciation in later years would not fully compensate the early taxes due to discounting.

FIGURE V.2 BASE SCENARIO NET CASH FLOW AND NET INCOME



The cash flows in the first three years are weak and are derived almost entirely from male calf sales. If the pricing assumption that male calves will fetch the NPV based price does not hold true, then negative cash flows in the initial years is a possibility. A continuing source of capital inflow would be needed for the first three years although this is not unusual in a developing enterprise.

The NPV of the base scenario discounted by the risk adjusted discount rate (10.3%) is $467,873 from an initial investment of $1,700,153. The break even year is year 15 when the initial investment is recouped. The NPV has accumulated to $442,635 in year 40 and the market value of the ranch is $1,269,146 in year 40. The herd value has decreased from the initial $905,385 (206 animals) to $851,247 (1,312 animals). The NPV represents an approximate expected IRR of 12% (Table V.6) with a minimmum rate of return of approximately 5%.

The assumption has been made that the expected venison price remains constant through out the model in the absence of better information. This assumption causes cash flows to essentially level out around year 24. The uncertainty associated with the trend venison price in later years is compensated for by the discounting process in which small changes in later cash flows will not significantly effect the NPV.

The assumption that the market value of the ranch in year 40 is based on productivity can be questioned. The average net income in the last five years of the simulation is $130,595. The year 40 value[19] of that net income in perpetuity is $1,269,146 (the market value calculated in the model). The value of the breeding herd is approximately $851,260 which leaves $417,886 as the productive value of the land (returns to labor is included in the net income). The land value based on venison production is therefore less than the orignal purchase price for the land ($502,102)[20]; productive value is $189.26/ha compared to $227.40/ha purchase value.

The conclusion can be drawn that the market value of the ranch in year 40 may be greater than the value based on productivity if land values are not expected to fall. This difference would cause a slight increase in the NPV. It could also be argued that the game ranch should be discountinued at that time as the opportunity cost of not liquidating the assets is higher than the value of continued production. In any case the NPV of a new game ranch established in year 40 would be negative at the current expected venison price.

Sensitivity Analysis

The NPV is extremely sensitive to a number of price parameters that have been arbitrarily assumed. Discounting inherently places the greatest emphasis on the early cash flows. The largest cash flows are found between the years of 5 and 17. These cash flows are primarily a result of female live sales. The area of greatest uncertainty is in the price trend for females.

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[19] This assumes the risk premium remains the same, no assessment of risk can be made for that period.

[20] This was uncleared land, some of which was cleared during the simulation which should increase the land value.

The rate of female price increase, the year that the price starts decreasing, and the rate of decrease all significantly affect NPV. Table V.8 shows the effect of different rates of price increase for the first five years followed by a 10% decrease per year on the NPV and the breakeven year. If the price does not rise at all, then the NPV is negative. As expected the greater the increase, the greater the NPV and the earlier the breakeven year. Figure V.3 shows the NPV through time for an increase of 10%, 15% (Base Scenario) and 20%. The positive NPV is based primarily on profits from high female prices in the first ten years. The people who enter the industry after the first two years or so, drive the price up and generate windfall profits for the existing and currently establishing ranches. However, these latecomers will be faced with a declining price by the time they are ready to sell any animals, resulting in a negative NPV for them.

Changing the number of years that the female price increases (prices increase 15% and then decrease 10%) also severely effects the NPV. Table V.9 shows the effect of changing the peak price year[21] on the breakeven year, herd structure change year and NPV. The NPV ranges from -$135,303

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[21] Velvet and male prices also start to decline in that year.

FIGURE V.3 NET PRESENT VALUE FOR THREE RATES OF FEMALE PRICE INCREASE

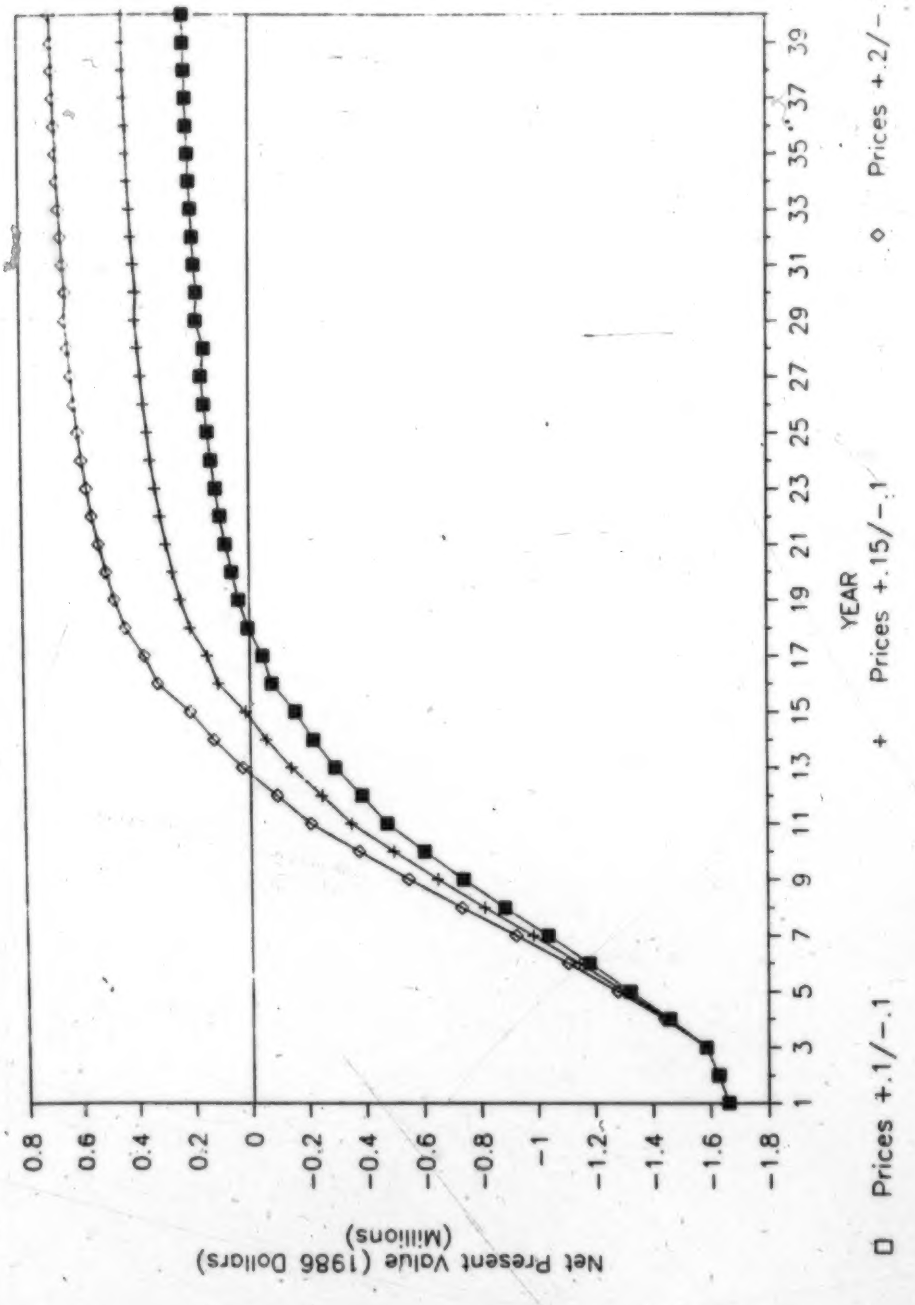

TABLE V.8 NPV FOR DIFFERENT RATE OF BREEDING PRICE INCREASE

Rate[1] (%)	Break Even Year	Net Present Value
0	over 40	$-94,825
5	31	$ 66,395
10	18	$253,320
[*]15	15	$467,873
20	13	$714,052

[1] Percent increase for female price in first five years
[*] Base Scenario

TABLE V.9 NPV FOR DIFFERENT BREEDING PRICE PEAK YEARS

Peak Year[1]	Break Even Year	Harvest Change Year	Net Present Value
3	over 40	14	$-135,303
4	23	15	$ 142,187
[*]5	15	16	$ 467,873
6	13	17	$ 858,801
7	11	19	$1,300,485

[1] The year female prices peak.
[*] Base Scenario

TABLE V.10 NPV FOR DIFFERENT RATES OF BREEDING PRICE DECREASE

Rate[1] (%)	Break Even Year	Harvest Change Year	Net Present Value
5	12	27	$1,319,504
[*]10	15	16	$ 467,873
15	29	12	$ 73,682

[1] Breeding price decrease per year starting in year 6.
[*] Base Scenario

for prices peaking in year 3, to $1,300,485 for prices peaking in year 7. Table V.10 shows the effect on NPV for different rates of price decrease after 5 years of a 15% increase. The NPV drops from $1,319,504 for a 5% decrease, to $73,692 for a 15% decrease. The timing of the peak year and rates of increase and decrease all depend on the future price expectations of new game ranchers. Rational analysis for a large commercial game ranch, as examined here, leads one to conclude that at higher female prices, game ranching is not feasible. However, the demand for females may be generated by smaller operators with shorter establishment periods for whom game ranching at higher prices may be feasible.

The other arbitrary parameter that significantly affects the NPV is the size of the initial herd. Table V.11 gives the initial investment, breakeven year and NPV for various initial wapiti herd sizes with the base price scenario. The minimum herd size for a positive NPV is in excess of 100 wapiti. The NPV varies from $-9,618 for 100 animals to $2,155,569 for 300 animals. It is unlikely there is a herd in excess of 300 to purchase. An impediment to the establishment of commercial game ranches is the lack of breeding stock currently available. There is one case of a herd of 117 recently purchased from the United States (J. Bunnage pers. comm.). By the time sufficient breeding stock is available, prices will likely have peaked making the venture infeasible.

TABLE V.11 NPV FOR DIFFERENT INITIAL WAPITI HERD SIZES

Herd Size	Initial Investment	Break Even Year	Net Present Value
100	$1,190,566	over 40	$ -9,618
125	$1,315,111	23	$142,815
150	$1,434,431	18	$271,497
*200	$1,700,153	15	$467,873
250	$1,924,079	13	$640,595
300	$2,155,569	12	$828,911

*Base Scenario

As an investment, a commercial game ranch would be good provided that sufficient breeding stock could be obtained. The positive expected NPV of $467,873 translates into $23,612,854 in year 40 from an initial investment of $1,700,153. The expected IRR is about 12% (real rate) with a minimum return of 5%. There is however, a high degree of risk involved as female prices must continue to rise for at least four years at 15% per year. It is also a long term investment which breaks even in year 15.

VI. SUMMARY, CONCLUSIONS AND IMPLICATIONS

A. Purpose and Objectives

An expansion of agricultural activities is seen as one means of furthering the development of northern Alberta. Traditional agricultural activities are marginal in this region due to relatively few frost free days. It has been suggested that game ranching is a viable alternative for agricultural development in this region. Native species display several ecological advantages over traditional livestock species that better suit them to northern Alberta conditions. The purpose of this study is to examine the economic feasibility of establishing a game ranch in northern Alberta.

The objectives of this study were fivefold. The first objective was to review the biological information as it pertains to game ranch production and management, including a review of the institutional framework that governs the structure and developement of game ranching. The second objective was to determine the costs, returns and risks of establishing and operating a game ranch. The third objective was to develop an efficient production strategy for a sample game ranch. The fourth objective was to simulate the operation of the sample ranch from establishment to maturity to enable an investment analysis. The final objective was to assess the sensitivity of the game ranch to various economic parameters.

B. Procedures Followed

A case study approach was taken in this study. The Kikino Wildlife Ranch on the Kikino Metis Settlement near Lac La Biche was selected as the case study area. Native and metis groups have been proposed as groups having a suitable land base and likely to engage in game ranching. Kikino represents a recently established metis game ranch in northern Alberta. As Kikino was a pilot project, many of the establishment practices were suboptimal and some costs were covered by donations or grants. This study treats the Kikino ranch as established in 1986 and using current knowledge, materials and costs.

The initial investment required (such as land, fences and equipment) was identified and priced with 1986 prices. Information on the biology of the three potential species and ranch management was gathered from the literature, game ranching workshops, and visits to existing operations. Operational expenses were identified and, where specific costs were unavailable, costs from cattle operations were used. Prices for the various game ranch products were obtained from the literature and from a questionnaire filled out by existing producers. Insufficient data were received on male wapiti prices. Therefore, a model was developed to calculate the male prices based on the net present value (NPV) of venison and velvet production.

There are two major sources of uncertainty. The first source is production uncertainty in the biological parameters such as fecundity and mortality. A probability distribution is specified for existing parameters, and an expected value derived. The second source of uncertainty is price uncertainty. A probability distribution is specified for current product prices, which is a considerable source of risk. Likely future price trends were postulated drawing on economic theory.

An efficient production strategy was developed through the use of linear programming. An annual process model constrained by the forage resources was developed. The primary results sought were the efficent herd size, structure and products. The major factor affecting changes in the production strategy was product prices. The changes in production strategy were examined for likely future product prices.

An investment in a game ranch is considered acceptable if the NPV is positive and is greater than alternative land uses. To derive the NPV it is necessary to discount the yearly cash flows of the ranch by the risk adjusted discount rate (which reflects the cost of capital). To derive the yearly cash flows and NPV, a systems model was developed to simulate the case ranch operation year by year from establishment to maturity. A Monte Carlo simulation of the systems model using the risk free discount rate and varying production and price parameters, resulted in an expected NPV and standard deviation. Using the resultant coefficient of variation in the capital asset pricing model gave the risk adjusted discount rate, which was then used in the systems model to derive the NPV.

A base price trend scenario of female wapiti live prices increasing by 15% per year for 5 years, then decreasing 10% annually to slaughter values (male wapiti and velvet prices also declined after 5 years), was assumed in the Monte Carlo simulation. The risk associated with changes in the assumed price trend (rate of increase, timing of the peak year, and rate of decrease) was measured by a sensitivity analysis on these key price trend parameters.

C. Conclusions

Game ranching will concentrate on the production of wapiti. Mixed species ranching, while an appealing concept, is not profit maximizing. Other species such as moose should only be considered if they utilize a resource such as browse on unclearable land that does not compete with wapiti production. Intensive management will be carried out including such activities as winter feeding and land clearing.

At current prices, the efficient production strategy is to produce wapiti breeding stock, selling females at three years and males as calves. The production strategy changes only when the live price of females declines to near slaughter value. The production strategy is then to slaughter males at two years after velveting[22], and sell two year-old females either live or for slaughter, depending on price. Only if velvet prices drop below $35/kg should males be slaughtered as yearlings.

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[22] It is assumed that two year old males can be sold as Grade A venison while three year olds can not.

Moose can be raised on any unclearable land to utilize the browse resource. In the absence of breeding stock markets, males and females should be slaughtered as yearlings.

There is a high positive expected NPV for a commercial game ranch. However, the initial investment is high. The primary component of the initial investment is breeding stock. The size of the NPV is directly related to the initial herd size. Capital shortages resulting in a small initial herd size with the intention to build up the herd can cause a negative NPV.

The most likely price trend scenario[33] results in positive cash flows throughout the life of the investment[34] providing male calf prices remain at current levels for the first three years. Net income based on accrual accounting will give a misleading picture showing incredible gains in the first years while prices rise, followed by poor levels as prices decrease. However, the underlying sales are strong. The IRR is about 12% while the breakeven period is around 15 years.

The risk involved in game ranching is fairly high. The required rate of return is 10.3%[35] based on undiversifiable risk associated with production and price uncertainty. The NPV coefficient of variation at a 10.8% discount rate is 2.0. The greatest source of risk deals with the expected price trend for females. Minor changes in the base price trend scenario causes large changes in the NPV. Significantly, if female prices do not rise in the first few years, then the NPV is negative provided the ranch has a stratgey of starting from a small initial herd. The negative NPV is a result of buying females at high prices while not producing until prices have declined.

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[33] Female prices rise by 15% annually for 5 years then drop 10% annually until slaughter value is reached.

[34] The negative cash flow in year 30 in reality could be spread over several years.

In the long term when the industry and live prices are based on venison production, expected annual net income averages $130,595 for the Kikino ranch ($59/ha)[36]. The economic rent to the land after subtracting the value of the breeding herd, is $189.26/ha. The economic rent to the land of the game ranch established in 1986 is $439.30/ha. The purchase price of $227.40/ha makes game ranching currently viable but puts in question the long term feasibility. In other words, game ranches starting today have a long term future, as capital costs are recovered by the high initial prices. However, game ranches are not likely to be established in northern Alberta when production is based on venison at current venison prices.

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[35] This is a real rate without an expected inflation component.

[36] Today's venison price and a velvet price of $55/kg is assumed.

D. Limitations

As in any study, findings are only as good as the data they are based on. Since game ranching is a new activity, many of the biological parameters were taken from wild populations subject to conditions different from those likely to exist on game ranches. Thus, the parameters had a wide distribution causing a large standard deviation around the expected NPV. The unorganized nature of the current Canadian game markets results in the wide ranging estimates of product prices, as revealed in the questionnaire results. The prices quoted and used are in some cases, the responses from one or two returns.

The NPV derived in this study is not necessarily the highest NPV possible. While linear programming derived the optimal herd structures, the process of reaching the target structure was not optimized. Another problem was encountered in determining at what prices the target structure changed. Post optimal analysis gave solution changes when one price was varied, but not when several prices varied. The prices for structure change were estimated through discrete approximation of price changes. Future research might take a dynamic programming approach to optimize the herd build-up phase.

This study provides a good first look at the economics of game ranching in northern Alberta. As more information becomes available on such matters as parameter values and prices, further study should be done. Production functions will be easier to specify and many of the assumptions can be replaced by empirical findings. Until that time, this study provides important information for preliminary decisions about the economic viability of game ranching in northern Alberta.

E. Implications and Recommendations

At current velvet prices, the value of retaining male wapiti for velvet production is greater than their value from slaughter as yearlings. At the same time the opportunity cost of retaining males older than calves on a breeding ranch at carrying capacity is high. The opportunity, therefore, exists for the establishment of specialist velvet ranches that maintain male only herds for velvet production. Because of the opportunity cost of keeping males older than calves, breeding ranches would be willing to sell calves or yearlings at prices below the NPV from velvet. Thus allowing the velvet ranch to capture part of the NPV. These velvet ranches could survive as long as velvet prices remain above $75/kg.

The number of large commercial game ranches that will be established is in question. The major impediment is the lack of breeding stock available today as commercial ranches need initial herds in excess of 100 animals. The high net incomes available in the first years due to breeding herd appreciation, may induce the establishment of new ranches. In fact the viability of ranches being established today is based, in part, on subsequent established ranches driving up breeding prices as today's herds come into production. The stage is then set for potential large losses by the subsequent ranches.

One group of people for whom game ranching does have considerable potential are the Indian and Metis. For these people the land (reserve and settlement land) is available and has a low opportunity cost[37] as ownership is non transferable and alternative uses are limited. When the land value is added back into the NPV figures, the expected NPV under all price scenarios is positive. Even the lowest NPV of the Monte Carlo simulation (at the 10.8% discount rate) is only $-391,459[38] Game ranching is therefore a lower risk option for natives, even when production is venison based.

There is currently much public debate on whether or not meat sales should be permitted. Providing the objection that poached meat will be able to enter the market can be satisfied, meat sales should be legalized. The meat inspection regulations requiring *ante mortum* inspection, combined with the record keeping regulations on ranches prevents the possibility of illegal wild meat being sold as game ranched meat. From a game ranch industry point of view, meat sales are essential for a long-term game ranching industry future.

An industry based on velvet production is very vulnerable. The major world consumer of velvet is Korea.

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[37] The economic rent of alternative land use.

[38] This represents a worst case scenario.

Korean buying is controlled by the Korean Pharmaceutical Traders Association which wields tremendous market power. To reduce the risk of a collapse in the velvet market (there is a current world over-supply), an alternative market must be available for game ranch products (the venison market). The establishment of a producer marketing cooperative similar to the New Zealand Game Industry Board would help counteract the Korean's market power and establish orderly markets for game products in Canada.

Game ranching has potential for northern Alberta. The number of large producers will be limited by the lack of available breeding stock. There will inevitably be producers who enter at high prices and suffer losses, but this is not unusual for any new industry. Perhaps the greatest potential is for native people, but it also provides a means for existing livestock producers to diversify their operations. No particular government subsidies are required, although current agricultural programs could apply.

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APPENDIX A: Simulation Results For The Base Scenario

Note:

1. Base Scenario - live prices rise 15%/yr for five years then decrease 10%/yr, velvet price decreases 2.5%/yr to $55/kg.
2. EBIT - Earnings Before Interest and Taxes.

```
YEARLY REPORT: YEAR 1
************************
1. POPULATION STATUS
              BISON               WAPITI               MOOSE
         POP    HARVEST      POP    HARVEST      POP    HARVEST
 AGE     M   F    M   F      M   F    M   F      M   F    M   F
 0YRS    0   0    0   0      4  73   69   0      2   1    0   0
 1YRS    0   0    0   0      0   0    0   0      0   0    0   0
 2YRS    0   0    0   0      0  51    0   0      0   0    0   0
 3YRS    0   0    0   0      1  48    0   0      1   3    0   0
 4YRS    0   0    0   0      2  46    0   0      0   1    0   0
 5YRS    0   0    0   0      1  42    0   0      1   0    0   0
 6YRS    0   0    0   0      1   0    0   0      0   0    0   0
 7YRS    0   0    0   0      0   0    0   0      0   0    0   0
 8YRS    0   0    0   0      0   0    0   0      0   0    0   0
 9YRS    0   0    0   0      0   0    0   0      0   0    0   0
10YRS    0   0    0   0      0   0    0   0      0   0    0   0
11YRS    0   0    0   0      0   0    0   0      0   0    0   0
12YRS    0   0    0   0      0   0    0   0      0   0    0   0
TOTAL    0   0    0   0      9 260   69   0      4   5    0   0
Total Population is  277

2.                   INCOME STATEMENT

INCOME
Live Sales              $133,218.43
Venison Sales                 $0.00
Velvet Sales              $1,893.11
Feeder Sales                  $0.00
Total Sales                                 $135,111.54
PLUS: End Inventory                       $1,204,737.78
LESS: Beg Inventory                         $905,385.00
                                          -------------
Gross Income                                $434,464.32

EXPENSES
Feed Costs               $14,500.33
Other Op. Costs          $22,511.66
Fixed Costs              $25,286.00
Land Clearing            $31,276.98
Depreciation             $11,644.19
Total Expenses                              $105,219.16
                                          -------------
EBIT                                        $329,245.16
Taxes                                             $0.00
                                          -------------
                                          -------------
NET INCOME                                  $329,245.16

3. CASH FLOW
Net Cash Flow                                $41,536.57
Discounted Cash Flow                         $37,661.23
Net Present Value                        -$1,662,492.27
```

```
YEARLY REPORT: YEAR 2
***********************
1. POPULATION STATUS.
             BISON               WAPITI              MOOSE
        POP     HARVEST      POP     HARVEST     POP     HARVEST
 AGE    M   F    M   F      M   F    M   F      M   F    M   F
 0YRS   0   0    0   0      5  78   73   0      2   2    0   0
 1YRS   0   0    0   0      4  68    0   0      0   1    1   0
 2YRS   0   0    0   0      0   0    0   0      0   0    0   0
 3YRS   0   0    0   0      0  49    0   0      0   0    0   0
 4YRS   0   0    0   0      1  46    0   0      1   3    0   0
 5YRS   0   0    0   0      2  44    0   0      0   1    0   0
 6YRS   0   0    0   0      1  41    0   0      1   0    0   0
 7YRS   0   0    0   0      1   0    0   0      0   0    0   0
 8YRS   0   0    0   0      0   0    0   0      0   0    0   0
 9YRS   0   0    0   0      0   0    0   0      0   0    0   0
10YRS   0   0    0   0      0   0    0   0      0   0    0   0
11YRS   0   0    0   0      0   0    0   0      0   0    0   0
12YRS   0   0    0   0      0   0    0   0      0   0    0   0
TOTAL   0   0    0   0     13 326   73   0      4   6    1   0
Total Population is   350

2.                  INCOME STATEMENT

INCOME
Live Sales                $142,251.66
Venison Sales               $1,347.74
Velvet Sales                $2,103.23
Feeder Sales                    $0.00
Total Sales                                     $145,702.62
PLUS: End Inventory                           $1,653,876.90
LESS: Beg Inventory                           $1,204,737.78
                                              -------------
Gross Income                                    $594,841.75

EXPENSES
Feed Costs                 $11,247.55
Other Op. Costs            $27,884.17
Fixed Costs                $26,286.00
Land Clearinq              $31,276.98
Depreciation               $11,644.19
Total Expenses                                  $108,338.89
                                              -------------
EBIT                                            $486,502.85
Taxes                                             $6,537.52
                                              -------------
                                              -------------
NET INCOME                                      $479,965.33

3. CASH FLOW
Net Cash Flow                                    $42,470.40
Discounted Cash Flow                             $34,915.16
Net Present Value                             -$1,627,577.11
```

```
YEARLY REPORT: YEAR 3
************************
1. POPULATION STATUS
             BISON             WAPITI             MOOSE
        POP    HARVEST     POP    HARVEST     POP    HARVEST
AGE     M   F   M   F     M   F    M   F     M   F   M   F
 0YRS   0   0   0   0     4  92   88   0     2   2   0   0
 1YRS   0   0   0   0     5  74    0   0     1   1   1   0
 2YRS   0   0   0   0     4  66    0   0     0   1   0   0
 3YRS   0   0   0   0     0   0    0   0     0   0   0   0
 4YRS   0   0   0   0     0  47    0   0     0   0   0   0
 5YRS   0   0   0   0     1  44    0   0     1   2   0   0
 6YRS   0   0   0   0     2  42    0   0     0   1   0   0
 7YRS   0   0   0   0     1  39    0   0     0   0   1   0
 8YRS   0   0   0   0     1   0    0   0     0   0   0   0
 9YRS   0   0   0   0     0   0    0   0     0   0   0   0
10YRS   0   0   0   0     0   0    0   0     0   0   0   0
11YRS   0   0   0   0     0   0    0   0     0   0   0   0
12YRS   0   0   0   0     0   0    0   0     0   0   0   0
TOTAL   0   0   0   0    17 404   88   0     4   7   1   0
Total Population is  432

2.                  INCOME STATEMENT

INCOME
Live Sales            $171,303.04
Venison Sales           $1,588.78
Velvet Sales            $3,574.93
Feeder Sales                $0.00
Total Sales                                 $176,466.75
PLUS: End Inventory                       $2,387,305.44
LESS: Beg Inventory                       $1,653,876.90
                                          -------------
Gross Income                                $909,895.30

EXPENSES
Feed Costs             $11,325.64
Other Op. Costs        $34,436.10
Fixed Costs            $27,286.00
Land Clearing          $31,276.98
Depreciation           $11,644.19
Total Expenses                              $115,968.91
                                          -------------
EBIT                                        $793,926.38
Taxes                                        $15,196.37
                                          =============

NET INCOME                                  $778,730.02

3. CASH FLOW
Net Cash Flow                                $56,945.66
Discounted Cash Flow                         $42,447.51
Net Present Value                        -$1,585,129.59
```

```
YEARLY REPORT: YEAR 4
************************
1. POPULATION STATUS
               BISON              WAPITI             MOOSE
          POP     HARVEST      POP    HARVEST     POP    HARVEST
 AGE     M    F    M    F    M    F    M    F    M    F    M    F
 0YRS    0    0    0    0    5  118  113    0    3    2    0    0
 1YRS    0    0    0    0    4   87    0    0    0    1    2    0
 2YRS    0    0    0    0    5   71    0    0    1    1    0    0
 3YRS    0    0    0    0    3   36    0   27    0    1    0    0
 4YRS    0    0    0    0    0    0    0    0    0    0    0    0
 5YRS    0    0    0    0    0   45    0    0    0    0    0    0
 6YRS    0    0    0    0    1   42    0    0    1    2    0    0
 7YRS    0    0    0    0    2   41    0    0    0    1    0    0
 8YRS    0    0    0    0    1   37    0    0    0    0    0    0
 9YRS    0    0    0    0    1    0    0    0    0    0    0    0
10YRS    0    0    0    0    0    0    0    0    0    0    0    0
11YRS    0    0    0    0    0    0    0    0    0    0    0    0
12YRS    0    0    0    0    0    0    0    0    0    0    0    0
TOTAL    0    0    0    0   21  477  113   27    4    8    2    0
Total Population is  511

2.                  INCOME STATEMENT

INCOME
Live Sales              $418,103.71
Venison Sales             $1,929.73
Velvet Sales              $5,136.11
Feeder Sales                  $0.00
Total Sales                                  $425,169.55
PLUS: End Inventory                        $3,219,098.52
LESS: Beg Inventory                        $2,387,305.44
                                           -------------
Gross Income                               $1,256,962.62

EXPENSES
Feed Costs               $13,454.88
Other Op. Costs          $45,084.48
Fixed Costs              $28,286.00
Land Clearing            $31,276.98
Depreciation             $11,644.19
Total Expenses                               $129,746.53
                                           -------------
EBIT                                       $1,127,216.09
Taxes                                        $106,814.63
                                           -------------
                                           -------------
NET INCOME                                 $1,020,401.46

3. CASH FLOW
Net Cash Flow                                $200,252.58
Discounted Cash Flow                         $135,342.31
Net Present Value                         -$1,449,787.29
```

```
YEARLY REPORT: YEAR 5
************************
1. POPULATION STATUS
                BISON               WAPITI              MOOSE
          POP     HARVEST      POP    HARVEST      POP     HARVEST
 AGE      M   F    M    F     M    F    M    F     M    F    M    F
 0YRS     0   0    0    0     4  135  131    0     3    3    0    0
 1YRS     0   0    0    0     5  111    0    0     1    1    1    0
 2YRS     0   0    0    0     4   83    0    0     0    1    0    0
 3YRS     0   0    0    0     4   37    0   31     1    1    0    0
 4YRS     0   0    0    0     3   35    0    0     0    1    0    0
 5YRS     0   0    0    0     0    0    0    0     0    0    0    0
 6YRS     0   0    0    0     0   43    0    0     0    0    0    0
 7YRS     0   0    0    0     1   41    0    0     0    2    1    0
 8YRS     0   0    0    0     2   39    0    0     0    1    0    0
 9YRS     0   0    0    0     1   36    0    0     0    0    0    0
10YRS     0   0    0    0     1    0    0    0     0    0    0    0
11YRS     0   0    0    0     0    0    0    0     0    0    0    0
12YRS     0   0    0    0     0    0    0    0     0    0    0    0
TOTAL     0   0    0    0    24  561  131   31     5   10    1    0
Total Population is  599

2.                   INCOME STATEMENT

INCOME
Live Sales               $517,034.07
Venison Sales              $1,600.37
Velvet Sales               $6,470.72
Feeder Sales                   $0.00
Total Sales                                    $525,105.16
PLUS: End Inventory                          $4,273,956.22
LESS: Beg Inventory                          $3,219,098.52
                                             ______________
Gross Income                                 $1,579,962.87

EXPENSES
Feed Costs                $14,680.85
Other Op. Costs           $53,438.56
Fixed Costs               $29,286.00
Land Clearing             $31,276.98
Depreciation              $11,644.19
Total Expenses                                 $140,326.57
                                             ______________
EBIT                                         $1,439,636.29
Taxes                                          $153,866.84
                                             ______________
                                             ______________
NET INCOME                                   $1,285,769.45

3. CASH FLOW
Net Cash Flow                                  $242,555.94
Discounted Cash Flow                           $148,638.47
Net Present Value                           -$1,301,148.81
```

```
YEARLY REPORT: YEAR 6
************************
1. POPULATION STATUS
            BISON                 WAPITI                MOOSE
        POP    HARVEST        POP    HARVEST       POP    HARVEST
 AGE    M   F    M    F     M   F    M     F     M   F    M    F
 0YRS   0   0    0    0     5 159  154     0     4   3    0    0
 1YRS   0   0    0    0     4 128    0     0     0   2    2    0
 2YRS   0   0    0    0     5 107    0     0     1   1    0    0
 3YRS   0   0    0    0     3  36    0    44     0   1    0    0
 4YRS   0   0    0    0     4  36    0     0     1   1    0    0
 5YRS   0   0    0    0     3  33    0     0     0   1    0    0
 6YRS   0   0    0    0     0   0    0     0     0   0    0    0
 7YRS   0   0    0    0     0  41    0     0     0   0    0    0
 8YRS   0   0    0    0     1  39    0     0     0   2    0    0
 9YRS   0   0    0    0     2  38    0     0     0   1    0    0
10YRS   0   0    0    0     1  34    0     0     0   0    0    0
11YRS   0   0    0    0     1   0    0     0     0   0    0    0
12YRS   0   0    0    0     0   0    0     0     0   0    0    0
TOTAL   0   0    0    0    28 651  154    44     5  11    2    0
Total Population is  695

2.                  INCOME STATEMENT

INCOME
Live Sales             $604,347.74
Venison Sales            $2,407.73
Velvet Sales             $8,096.76
Feeder Sales                 $0.00
Total Sales                                   $614,852.23
PLUS: End Inventory                         $4,427,704.31
LESS: Beg Inventory                         $4,273,956.22
                                           ______________
Gross Income                                  $768,600.32

EXPENSES
Feed Costs              $18,339.54
Other Op. Costs         $62,144.42
Fixed Costs             $30,286.00
Land Clearing           $31,276.98
Depreciation            $11,644.19
Total Expenses                                $153,691.13
                                           ______________
EBIT                                          $614,909.19
Taxes                                         $194,013.05
                                           ______________
                                           ______________
NET INCOME                                    $420,896.14

3. CASH FLOW
Net Cash Flow                                 $278,792.25
Discounted Cash Flow                          $154,904.44
Net Present Value                          -$1,146,244.37
```

```
YEARLY REPORT: YEAR 7
***********************
1. POPULATION STATUS
           BISON            WAPITI          MOOSE
        POP   HARVEST    POP   HARVEST   POP   HARVEST
 AGE    M  F   M  F     M   F   M   F    M  F   M  F
 0YRS   0  0   0  0     4 184 180   0    4  3   0  0
 1YRS   0  0   0  0     5 150   0   0    1  2   1  0
 2YRS   0  0   0  0     4 123   0   0    0  2   0  0
 3YRS   0  0   0  0     4  37   0  65    1  1   0  0
 4YRS   0  0   0  0     3  35   0   0    0  1   0  0
 5YRS   0  0   0  0     4  34   0   0    1  1   0  0
 6YRS   0  0   0  0     3  32   0   0    0  1   0  0
 7YRS   0  0   0  0     0   0   0   0    0  0   0  0
 8YRS   0  0   0  0     0  40   0   0    0  0   0  0
 9YRS   0  0   0  0     1  38   0   0    0  2   0  0
10YRS   0  0   0  0     2  36   0   0    0  0   0  0
11YRS   0  0   0  0     1  33   0   0    0  0   0  0
12YRS   0  0   0  0     0   0   1   0    0  0   0  0
TOTAL   0  0   0  0    30 740 181  65    7 13   1  0
Total Population is  790

2.                  INCOME STATEMENT

INCOME
Live Sales              $731,286.03
Venison Sales             $2,364.49
Velvet Sales              $9,308.31
Feeder Sales                  $0.00
Total Sales                                  $742,958.83
PLUS: End Inventory                        $4,492,037.02
LESS: Beg Inventory                        $4,427,704.31
                                           --------------
Gross Income                                 $807,291.54

EXPENSES
Feed Costs               $22,779.80
Other Op. Costs          $71,511.71
Fixed Costs              $31,286.00
Land Clearing            $31,276.98
Depreciation             $11,644.19
Total Expenses                               $168,498.68
                                           --------------
EBIT                                         $638,792.86
Taxes                                        $250,840.16
                                           --------------
                                           --------------
NET INCOME                                   $387,952.70

3. CASH FLOW
Net Cash Flow                                $320,264.18
Discounted Cash Flow                         $161,344.96
Net Present Value                           -$984,899.41
```

```
YEARLY REPORT: YEAR 8
************************
1. POPULATION STATUS
              BISON              WAPITI             MOOSE
         POP     HARVEST     POP     HARVEST     POP    HARVEST
 AGE    M    F    M    F    M    F    M    F    M    F    M    F
 0YRS   0    0    0    0    5  207  202    0    5    4    0    0
 1YRS   0    0    0    0    4  173    0    0    0    2    3    0
 2YRS   0    0    0    0    5  144    0    0    1    2    0    0
 3YRS   0    0    0    0    3   36    0   82    0    1    0    0
 4YRS   0    0    0    0    4   36    0    0    1    1    0    0
 5YRS   0    0    0    0    3   33    0    0    0    1    0    0
 6YRS   0    0    0    0    4   33    0    0    1    1    0    0
 7YRS   0    0    0    0    3   31    0    0    0    1    0    0
 8YRS   0    0    0    0    0    0    0    0    0    0    0    0
 9YRS   0    0    0    0    0   38    0    0    0    0    0    0
10YRS   0    0    0    0    1   36    0    0    0    1    0    0
11YRS   0    0    0    0    1   35    0    0    0    0    0    0
12YRS   0    0    0    0    0    0    1   32    0    0    0    0
TOTAL   0    0    0    0   33  801  203  113    7   15    3    0
Total Population is  856

2.                   INCOME STATEMENT

INCOME
Live Sales                $790,016.69
Venison Sales              $27,291.35
Velvet Sales               $10,408.30
Feeder Sales                    $0.00
Total Sales                                   $827,716.34
PLUS: End Inventory                         $4,359,287.73
LESS: Beg Inventory                         $4,492,037.02
                                            -------------
Gross Income                                  $694,967.04

EXPENSES
Feed Costs                 $24,306.13
Other Op. Costs            $77,965.59
Fixed Costs                $32,286.00
Land Clearing              $31,276.98
Depreciation               $11,644.19
Total Expenses                                $177,478.89
                                            -------------
EBIT                                          $517,488.15
Taxes                                         $290,502.80
                                            -------------
                                            -------------
NET INCOME                                    $226,985.36

3. CASH FLOW
Net Cash Flow                                 $371,378.84
Discounted Cash Flow                          $169,639.92
Net Present Value                            -$815,259.49
```

```
YEARLY REPORT: YEAR 9
************************
1. POPULATION STATUS
              BISON            WAPITI            MOOSE
         POP   HARVEST     POP   HARVEST     POP   HARVEST
 AGE     M   F   M   F     M   F   M   F     M   F   M   F
 0YRS    0   0   0   0     4 219 215   0     6   5   0   0
 1YRS    0   0   0   0     5 195   0   0     1   3   2   0
 2YRS    0   0   0   0     4 166   0   0     0   2   0   0
 3YRS    0   0   0   0     4  37   0 101     1   2   0   0
 4YRS    0   0   0   0     3  35   0   0     0   1   0   0
 5YRS    0   0   0   0     4  34   0   0     1   1   0   0
 6YRS    0   0   0   0     3  32   0   0     0   1   0   0
 7YRS    0   0   0   0     4  31   0   0     0   1   1   0
 8YRS    0   0   0   0     3  29   0   0     0   0   0   0
 9YRS    0   0   0   0     0   0   0   0     0   0   0   0
10YRS    0   0   0   0     0  37   0   0     0   0   0   0
11YRS    0   0   0   0     1  35   0   0     0   1   0   0
12YRS    0   0   0   0     0   0   1  33     0   0   0   0
TOTAL    0   0   0   0    34 850 216 134     8  16   3   0
Total Population is  909

2.                   INCOME STATEMENT

INCOME
Live Sales                 $834,626.97
Venison Sales               $29,372.26
Velvet Sales                $11,164.99
Feeder Sales                     $0.00
Total Sales                                    $875,164.23
PLUS: End Inventory                          $4,196,575.46
LESS: Beg Inventory                          $4,359,287.73
                                             -------------
Gross Income                                   $712,451.96

EXPENSES
Feed Costs                  $20,141.85
Other Op. Costs             $82,716.13
Fixed Costs                 $33,286.00
Land Clearing               $31,276.98
Depreciation                $11,644.19
Total Expenses                                 $179,065.15
                                             -------------
EBIT                                           $533,386.81
Taxes                                          $315,082.45
                                             =============
NET INCOME                                     $218,304.36

3. CASH FLOW
Net Cash Flow                                  $392,660.82
Discounted Cash Flow                           $162,626.88
Net Present Value                             -$652,632.61
```

```
YEARLY REPORT: YEAR 10
***********************
1. POPULATION STATUS
            BISON           WAPITI           MOOSE
         POP   HARVEST    POP   HARVEST   POP   HARVEST
 AGE     M   F   M   F   M   F   M   F   M   F   M   F
 0YRS    0   0   0   0   5 231 226   0   6   5   0   0
 1YRS    0   0   0   0   4 207   0   0   0   3   4   0
 2YRS    0   0   0   0   5 188   0   0   1   2   0   0
 3YRS    0   0   0   0   3  36   0 124   0   2   0   0
 4YRS    0   0   0   0   4  36   0   0   1   2   0   0
 5YRS    0   0   0   0   3  33   0   0   0   1   0   0
 6YRS    0   0   0   0   4  33   0   0   1   1   0   0
 7YRS    0   0   0   0   3  31   0   0   0   1   0   0
 8YRS    0   0   0   0   4  30   0   0   0   1   0   0
 9YRS    0   0   0   0   3  28   0   0   0   0   0   0
10YRS    0   0   0   0   0   0   0   0   0   0   0   0
11YRS    0   0   0   0   0  35   0   0   0   0   0   0
12YRS    0   0   0   0   0   0   1  33   0   0   0   1
TOTAL    0   0   0   0  37 887 227 157   8  18   4   1
Total Population is  950

2.                  INCOME STATEMENT

INCOME
Live Sales             $877,333.23
Venison Sales           $30,424.42
Velvet Sales            $12,004.14
Feeder Sales                 $0.00
Total Sales                                 $919,761.79
PLUS: End Inventory                       $3,946,257.42
LESS: Beg Inventory                       $4,196,575.46
                                         ______________
Gross Income                                $669,443.75

EXPENSES
Feed Costs              $20,458.11
Other Op. Costs         $86,538.28
Fixed Costs             $34,286.00
Land Clearing            $1,513.48
Depreciation            $11,644.19
Total Expenses                              $154,440.05
                                         ______________
EBIT                                        $515,003.70
Taxes                                       $348,090.39
                                         ______________
                                         ______________
NET INCOME                                  $166,913.31

3. CASH FLOW
Net Cash Flow                               $405,805.54
Discounted Cash Flow                        $152,390.05
Net Present Value                          -$500,242.56
```

```
YEARLY REPORT: YEAR 11
************************
1. POPULATION STATUS
             BISON              WAPITI              MOOSE
        POP    HARVEST      POP    HARVEST      POP    HARVEST
 AGE    M   F   M   F     M   F   M   F       M   F   M   F
 0YRS   0   0   0   0     4 239 235   0       6   5   0   0
 1YRS   0   0   0   0     5 218   0   0       1   2   3   1
 2YRS   0   0   0   0     4 198   0   0       0   3   0   0
 3YRS   0   0   0   0     4  37   0 143       1   2   0   0
 4YRS   0   0   0   0     3  35   0   0       0   2   0   0
 5YRS   0   0   0   0     4  34   0   0       1   1   0   0
 6YRS   0   0   0   0     3  32   0   0       0   1   0   0
 7YRS   0   0   0   0     4  31   0   0       0   1   1   0
 8YRS   0   0   0   0     3  29   0   0       0   1   0   0
 9YRS   0   0   0   0     3  29   0   0       0   1   0   0
10YRS   0   0   0   0     3  27   0   0       0   0   0   0
11YRS   0   0   0   0     0   0   0   0       0   0   0   0
12YRS   0   0   0   0     0   0   0  34       0   0   0   0
TOTAL   0   0   0   0    40 909 235 177       9  19   4   1
Total Population is  977

2.                   INCOME STATEMENT

INCOME
Live Sales               $885,631.77
Venison Sales             $30,762.49
Velvet Sales              $13,014.43
Feeder Sales                   $0.00
Total Sales                                 $929,408.69
PLUS: End Inventory                       $3,645,829.64
LESS: Beg Inventory                       $3,946,257.42
                                          -------------
Gross Income                                $628,980.91

EXPENSES
Feed Costs                $20,991.83
Other Op. Costs           $88,681.99
Fixed Costs               $35,286.00
Land Clearing                  $0.00
Depreciation              $11,644.19
Total Expenses                              $156,604.01
                                          -------------
EBIT                                        $472,376.90
Taxes                                       $353,171.81
                                          -------------
                                          -------------
NET INCOME                                  $119,205.09

3. CASH FLOW
Net Cash Flow                               $431,277.06
Discounted Cash Flow                        $146,844.90
Net Present Value                          -$353,397.67
```

```
YEARLY REPORT: YEAR 12
***********************
1. POPULATION STATUS
             BISON               WAPITI               MOOSE
        POP     HARVEST      POP    HARVEST      POP    HARVEST
 AGE    M   F    M   F      M   F    M    F      M   F    M   F
 0YRS   0   0    0   0      5 243  238    0      7   6    0   0
 1YRS   0   0    0   0      4 225    0    0      0   3    4   0
 2YRS   0   0    0   0      5 209    0    0      1   2    0   0
 3YRS   0   0    0   0      3  36    0  154      0   2    0   0
 4YRS   0   0    0   0      4  36    0    0      1   2    0   0
 5YRS   0   0    0   0      3  33    0    0      0   2    0   0
 6YRS   0   0    0   0      4  33    0    0      1   1    0   0
 7YRS   0   0    0   0      3  31    0    0      0   1    0   0
 8YRS   0   0    0   0      4  30    0    0      0   1    0   0
 9YRS   0   0    0   0      3  28    0    0      0   1    0   0
10YRS   0   0    0   0      3  28    0    0      0   1    0   0
11YRS   0   0    0   0      3  26    0    0      0   0    0   0
12YRS   0   0    0   0      0   0    0    0      0   0    0   0
TOTAL   0   0    0   0     43 958  238  154     10  21    4   0
Total Population is 1032

2.                   INCOME STATEMENT

INCOME
Live Sales            $845,494.35
Venison Sales           $5,542.55
Velvet Sales           $14,619.75
Feeder Sales                $0.00
Total Sales                                $865,656.65
PLUS: End Inventory                      $3,455,587.60
LESS: Beg Inventory                      $3,645,829.64
                                         --------------
Gross Income                               $675,414.61

EXPENSES
Feed Costs             $22,529.36
Other Op. Costs        $91,441.53
Fixed Costs            $56,286.00
Land Clearing           $5,850.00
Depreciation           $13,580.19
Total Expenses                             $189,687.08
                                         --------------
EBIT                                       $485,727.53
Taxes                                      $304,638.13
                                         --------------
                                         --------------
NET INCOME                                 $181,089.39

3. CASH FLOW
Net Cash Flow                              $328,631.63
Discounted Cash Flow                       $101,455.53
Net Present Value                         -$251,942.14
```

```
YEARLY REPORT: YEAR 13
*************************
1. POPULATION STATUS
              BISON                 WAPITI               MOOSE
         POP     HARVEST       POP     HARVEST      POP     HARVEST
 AGE     M    F    M    F    M    F    M    F    M    F    M    F
 0YRS    0    0    0    0    4  261  257    0    8    7    0    0
 1YRS    0    0    0    0    5  229    0    0    1    2    4    2
 2YRS    0    0    0    0    4  216    0    0    0    3    0    0
 3YRS    0    0    0    0    4   37    0  164    1    2    0    0
 4YRS    0    0    0    0    3   35    0    0    0    2    0    0
 5YRS    0    0    0    0    4   34    0    0    1    2    0    0
 6YRS    0    0    0    0    3   32    0    0    0    1    0    0
 7YRS    0    0    0    0    4   31    0    0    0    1    1    0
 8YRS    0    0    0    0    3   29    0    0    0    1    0    0
 9YRS    0    0    0    0    3   29    0    0    0    1    0    0
10YRS    0    0    0    0    3   27    0    0    0    1    0    0
11YRS    0    0    0    0    3   27    0    0    0    0    0    0
12YRS    0    0    0    0    0    0    2   25    0    0    0    0
TOTAL    0    0    0    0   43  987  259  189   11   23    4    2
Total Population is 1064

2.                   INCOME STATEMENT

INCOME
Live Sales              $810,183.69
Venison Sales            $28,668.04
Velvet Sales             $15,607.16
Feeder Sales                  $0.00
Total Sales                                 $854,458.89
PLUS: End Inventory                       $3,202,458.80
LESS: Beg Inventory                       $3,455,587.60
                                          -------------
Gross Income                                $601,330.09

EXPENSES
Feed Costs               $23,073.97
Other Op. Costs          $93,509.78
Fixed Costs              $57,286.00
Land Clearing                 $0.00
Depreciation             $13,580.19
Total Expenses                              $187,449.94
                                          -------------
EBIT                                        $413,880.15
Taxes                                       $299,930.92
                                          -------------
                                          -------------
NET INCOME                                  $113,949.23

3. CASH FLOW
Net Cash Flow                               $380,658.22
Discounted Cash Flow                        $106,552.94
Net Present Value                           $145,389.20
```

```
YEARLY REPORT: YEAR 14
************************
1. POPULATION STATUS
               BISON               WAPITI             MOOSE
          POP    HARVEST      POP   HARVEST     POP   HARVEST
 AGE      M   F   M   F      M   F   M   F     M   F   M   F
 0YRS     0   0   0   0      5 265 260   0     9   7   0   0
 1YRS     0   0   0   0      4 246   0   0     0   3   5   1
 2YRS     0   0   0   0      5 220   0   0     1   2   0   0
 3YRS     0   0   0   0      3  36   0 172     0   3   0   0
 4YRS     0   0   0   0      4  36   0   0     1   2   0   0
 5YRS     0   0   0   0      3  3[illegible]   0   0     0   2   0   0
 6YRS     0   0   0   0      4  35   0   0     1   2   0   0
 7YRS     0   0   0   0      3  31   0   0     0   1   0   0
 8YRS     0   0   0   0      4  30   0   0     0   1   0   0
 9YRS     0   0   0   0      3  28   0   0     0   1   0   0
10YRS     0   0   0   0      3  28   0   0     0   1   0   0
11YRS     0   0   0   0      3  26   0   0     0   0   0   0
12YRS     0   0   0   0      0   0   3  26     0   0   0   0
TOTAL     0   0   0   0    431011 263 197    11  24   5   2
Total Population is 1089

2.                  INCOME STATEMENT

INCOME
Live Sales                 $758,477.19
Venison Sales               $30,607.54
Velvet Sales                $15,526.64
Feeder Sales                     $0.00
Total Sales                                      $804,611.37
PLUS: End Inventory                            $2,947,753.62
LESS: Beg Inventory                            $3,202,458.80
                                              --------------
Gross Income                                     $549,906.20

EXPENSES
Feed Costs                  $27,421.12
Other Op. Costs             $94,332.15
Fixed Costs                 $58,286.00
Land Clearing                   -$0.00
Depreciation                $13,580.19
Total Expenses                                   $193,619.46
                                              --------------
EBIT                                             $356,286.74
Taxes                                            $270,523.97
                                              ==============
NET INCOME                                        $85,762.77

3. CASH FLOW
Net Cash Flow                                    $339,048.13
Discounted Cash Flow                              $86,050.91
Net Present Value                                -$59,338.29
```

```
YEARLY REPORT: YEAR 15
************************
1. POPULATION STATUS
                BISON                   WAPITI                MOOSE
           POP     HARVEST        POP    HARVEST        POP    HARVEST
 AGE       M    F    M    F     M    F    M    F      M    F    M    F
 0YRS      0    0    0    0     4  270  266    0      9    8    0    0
 1YRS      0    0    0    0     5  250    0    0      1    2    5    3
 2YRS      0    0    0    0     4  236    0    0      0    3    0    0
 3YRS      0    0    0    0     4   37    0  174      1    2    0    0
 4YRS      0    0    0    0     3   35    0    0      0    2    0    0
 5YRS      0    0    0    0     4   34    0    0      1    1    0    0
 6YRS      0    0    0    0     3   32    0    0      0    2    0    0
 7YRS      0    0    0    0     4   31    0    0      0    2    1    0
 8YRS      0    0    0    0     3   29    0    0      0    1    0    0
 9YRS      0    0    0    0     3   29    0    0      0    1    0    0
10YRS      0    0    0    0     3   27    0    0      0    1    0    0
11YRS      0    0    0    0     3   27    0    0      0    1    0    0
12YRS      0    0    0    0     0    0    2   25      0    0    0    0
TOTAL      0    0    0    0    431037  269  199     12   25    5    3
Total Population is 1116

2.                    INCOME STATEMENT

INCOME
Live Sales                 $694,726.75
Venison Sales               $30,856.92
Velvet Sales                $14,836.55
Feeder Sales                     $0.00
Total Sales                                      $740,420.22
PLUS: End Inventory                            $2,727,505.08
LESS: Beg Inventory                            $2,947,753.62
                                               --------------
Gross Income                                     $520,171.68

EXPENSES
Feed Costs                  $32,185.36
Other Op. Costs             $94,941.21
Fixed Costs                 $59,286.00
Land Clearing                    $0.00
Depreciation                $13,580.19
Total Expenses                                   $199,992.76
                                                --------------
EBIT                                             $320,178.91
Taxes                                            $235,192.80
                                                --------------
                                                --------------
NET INCOME                                        $84,986.12

3. CASH FLOW
Net Cash Flow                                    $317,267.85
Discounted Cash Flow                              $73,010.28
Net Present Value                                 $13,671.99
```

```
YEARLY REPORT: YEAR 16
************************
1. POPULATION STATUS
              BISON              WAPITI              MOOSE
         POP     HARVEST      POP     HARVEST      POP    HARVEST
 AGE     M   F   M   F     M   F    M   F     M   F   M   F
 0YRS    0   0   0   0   278 278    0   0    10   8   0   0
 1YRS    0   0   0   0     4 255    0   0     0   3   6   2
 2YRS    0   0   0   0     2  48    3 192     1   2   0   0
 3YR[illegible]    0   0   0   0     3  47    0 179     0   3   0   0
 4YRS    0   0   0   0     4  36    0   0     1   2   0   0
 5YRS    0   0   0   0     3  33    0   0     0   2   0   0
 6YRS    0   0   0   0     4  33    0   0     1   1   0   0
 7YRS    0   0   0   0     3  31    0   0     0   2   0   0
 8YRS    0   0   0   0     4  30    0   0     0   1   0   0
 9YRS    0   0   0   0     3  28    0   0     0   1   0   0
10YRS    0   0   0   0     3  28    0   0     0   1   0   0
11YRS    0   0 [illegible]   0     3  26    0   0     0   1   0   0
12YRS    0   0   0   0     0   0    3  26     0   0   0   0
TOTAL    0   0   0   0   314 872    6 397    12  26   6   2
Total Population is 1224

2.                      INCOME STATEMENT

INCOME
Live Sales              $1,002,633.48
Venison Sales              $34,932.33
Velvet Sales               $14,760.01
Feeder Sales                    $0.00
Total Sales                                     $1,052,325.82
PLUS: End Inventory                             $2,160,900.83
LESS: Beg Inventory                             $2,727,505.08
                                                --------------
Gross Income                                      $485,721.57

EXPENSES
Feed Costs                 $32,082.78
Other Op. Costs           $108,375.84
Fixed Costs                $60,286.00
Land Clearing                   $0.00
Depreciation               $13,580.19
Total Expenses                                    $214,324.81
                                                --------------
EBIT                                              $271,396.76
Taxes                                             $388,269.19
                                                --------------
                                                --------------
NET INCOME                                       -$116,872.42

3. CASH FLOW
Net Cash Flow                                     $463,312.02
Discounted Cash Flow                               $96,670.81
Net Present Value                                 $110,342.80
```

```
YEARLY REPORT: YEAR 17
************************
1. POPULATION STATUS
               BISON                  WAPITI              MOOSE
          POP      HARVEST        POP      HARVEST     POP     HARVEST
AGE      M    F    M    F      M    F    M    F     M    F    M    F
 0YRS    0    0    0    0    205  205    0    0    10    8    0    0
 1YRS    0    0    0    0    262  262    0    0     1    2    5    3
 2YRS    0    0    0    0      2   48    2  197     0    3    0    0
 3YRS    0    0    0    0      2   46    0    0     1    2    0    0
 4YRS    0    0    0    0      3   45    0    0     0    2    0    0
 5YRS    0    0    0    0      4   34    0    0     1    1    0    0
 6YRS    0    0    0    0      3   32    0    0     0    2    0    0
 7YRS    0    0    0    0      4   31    0    0     0    1    1    0
 8YRS    0    0    0    0      3   29    0    0     0    2    0    0
 9YRS    0    0    0    0      3   29    0    0     0    1    0    0
10YRS    0    0    0    0      3   27    0    0     0    1    0    0
11YRS    0    0    0    0      3   27    0    0     0    1    0    0
12YRS    0    0    0    0      0    0    2   25     0    0    0    1
TOTAL    0    0    0    0    498  816    4  222    13   26    6    4
Total Population is 1352

2.                    INCOME STATEMENT

INCOME
Live Sales              $485,808.65
Venison Sales            $33,934.32
Velvet Sales             $13,553.51
Feeder Sales                  $0.00
Total Sales                                   $533,296.47
PLUS: End Inventory                         $2,031,731.16
LESS: Beg Inventory                         $2,160,900.83
                                            _____________
Gross Income                                  $404,126.81

EXPENSES
Feed Costs               $41,005.90
Other Op. Costs         $107,194.42
Fixed Costs              $61,286.00
Land Clearing                 $0.00
Depreciation             $13,580.19
Total Expenses                                $223,066.51
                                            _____________
EBIT                                          $181,060.29
Taxes                                         $120,418.72
                                            _____________
                                            _____________
NET INCOME                                     $60,641.57

3. CASH FLOW
Net Cash Flow                                 $203,391.43
Discounted Cash Flow                           $38,478.52
Net Present Value                             $148,821.32
```

```
YEARLY REPORT: YEAR 18
************************
1. POPULATION STATUS
            BISON            WAPITI           MOOSE
        POP   HARVEST      POP   HARVEST     POP   HARVEST
 AGE     M   F   M   F   M   F   M   F   M   F   M   F
 0YRS    0   0   0   0 211 211   0   0  10   8   0   0
 1YRS    0   0   0   0 194 194   0   0   0   3   7   2
 2YRS    0   0   0   0   2  48 250 204   1   2   0   0
 3YRS    0   0   0   0   2  46   0   0   0   3   0   0
 4YRS    0   0   0   0   2  44   0   0   1   2   0   0
 5YRS    0   0   0   0   3  43   0   0   0   2   0   0
 6YRS    0   0   0   0   4  33   0   0   1   1   0   0
 7YRS    0   0   0   0   3  31   0   0   0   2   0   0
 8YRS    0   0   0   0   4  30   0   0   0   1   0   0
 9YRS    0   0   0   0   3  28   0   0   0   1   0   0
10YRS    0   0   0   0   3  28   0   0   0   1   0   0
11YRS    0   0   0   0   3  26   0   0   0   1   0   0
12YRS    0   0   0   0   0   0   3  26   0   0   0   1
TOTAL    0   0   0   0 432 762 253 229  12  27   7   3
Total Population is 1233

2.                 INCOME STATEMENT

INCOME
Live Sales               $453,169.02
Venison Sales            $315,916.98
Velvet Sales              $76,047.47
Feeder Sales                   $0.00
Total Sales                                  $845,133.47
PLUS: End Inventory                        $1,714,158.66
LESS: Beg Inventory                        $2,031,731.16
                                          --------------
Gross Income                                 $527,560.98

EXPENSES
Feed Costs                $57,983.87
Other Op. Costs          $112,401.60
Fixed Costs               $62,286.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                               $246,251.66
                                          --------------
EBIT                                         $281,309.32
Taxes                                        $268,385.00
                                          --------------
                                          --------------
NET INCOME                                    $12,924.32

3. CASH FLOW
Net Cash Flow                                $344,077.00
Discounted Cash Flow                          $59,020.81
Net Present Value                            $207,842.13
```

```
YEARLY REPORT: YEAR 19
************************
1. POPULATION STATUS
             BISON                 WAPITI                MOOSE
        POP     HARVEST       POP    HARVEST       POP    HARVEST
 AGE    M   F    M    F     M    F    M    F     M    F    M    F
 0YRS   0   0    0    0   197  197    0    0    10    8    0    0
 1YRS   0   0    0    0   199  199    0    0     1    2    6    3
 2YRS   0   0    0    0     2   48  184  138     0    3    0    0
 3YRS   0   0    0    0     2   46    0    0     1    2    0    0
 4YRS   0   0    0    0     2   44    0    0     0    2    0    0
 5YRS   0   0    0    0     2   42    0    0     1    1    0    0
 6YRS   0   0    0    0     3   42    0    0     0    2    0    0
 7YRS   0   0    0    0     4   31    0    0     0    1    1    0
 8YRS   0   0    0    0     3   29    0    0     0    2    0    0
 9YRS   0   0    0    0     3   29    0    0     0    1    0    0
10YRS   0   0    0    0     3   27    0    0     0    1    0    0
11YRS   0   0    0    0     3   27    0    0     0    1    0    0
12YRS   0   0    0    0     0    0    2   25     0    0    0    1
TOTAL   0   0    0    0   423  762  186  163    13   27    6    4
Total Population is 1224

2.                  INCOME STATEMENT

INCOME
Live Sales                 $275,682.96
Venison Sales              $241,007.08
Velvet Sales                $57,048.62
Feeder Sales                     $0.00
Total Sales                                     $573,738.66
PLUS: End Inventory                           $1,565,913.19
LESS: Beg Inventory                           $1,714,158.66
                                              _____________
Gross Income                                    $425,493.19

EXPENSES
Feed Costs                  $41,356.54
Other Op. Costs            $104,350.98
Fixed Costs                 $63,286.00
Land Clearing                    $0.00
Depreciation                $13,580.19
Total Expenses                                  $222,573.71
                                              _____________
EBIT                                            $202,919.48
Taxes                                           $142,651.75
                                              _____________
                                              _____________
NET INCOME                                       $60,267.73

3. CASH FLOW
Net Cash Flow                                   $222,093.39
Discounted Cash Flow                             $34,542.12
Net Present Value                               $242,384.26
```

```
YEARLY REPORT: YEAR 20
************************
1. POPULATION STATUS
            BISON               WAPITI              MOOSE
        POP    HARVEST      POP    HARVEST      POP    HARVEST
 AGE    M   F   M   F    M   F    M   F     M   F   M   F
 0YRS   0   0   0   0  202 202    0   0    10   8   0   0
 1YRS   0   0   0   0  186 186    0   0     0   3   7   3
 2YRS   0   0   0   0    2  48  189 143     1   2   0   0
 3YRS   0   0   0   0    2  46    0   0     0   3   0   0
 4YRS   0   0   0   0    2  44    0   0     1   2   0   0
 5YRS   0   0   0   0    2  42    0   0     0   2   0   0
 6YRS   0   0   0   0    2  41    0   0     1   1   0   0
 7YRS   0   0   0   0    3  40    0   0     0   2   0   0
 8YRS   0   0   0   0    4  30    0   0     0   1   0   0
 9YRS   0   0   0   0    3  28    0   0     0   1   0   0
10YRS   0   0   0   0    3  28    0   0     0   1   0   0
11YRS   0   0   0   0    3  26    0   0     0   1   0   0
12YRS   0   0   0   0    0   0    3  26     0   0   0   1
TOTAL   0   0   0   0  413 762  192 169    13  27   7   3
Total Population is 1215

2.                   INCOME STATEMENT

INCOME
Live Sales              $257,622.75
Venison Sales           $247,870.07
Velvet Sales             $56,431.35
Feeder Sales                  $0.00
Total Sales                                 $561,924.17
PLUS: End Inventory                       $1,423,724.52
LESS: Beg Inventory                       $1,565,913.19
                                          ______________
Gross Income                                $419,735.50

EXPENSES
Feed Costs               $40,918.15
Other Op. Costs         $103,519.58
Fixed Costs              $64,286.00
Land Clearing                 $0.00
Depreciation             $13,580.19
Total Expenses                              $222,303.92
                                          ______________
EBIT                                        $197,431.58
Taxes                                       $133,895.92
                                          ______________
                                          ______________
NET INCOME                                   $63,535.66

3. CASH FLOW
Net Cash Flow                               $191,234.52
Discounted Cash Flow                         $26,967.68
Net Present Value                           $269,351.93
```

```
YEARLY REPORT: YEAR 21
************************
1. POPULATION STATUS
              BISON               WAPITI              MOOSE
         POP      HARVEST     POP     HARVEST     POP     HARVEST
 AGE    M    F    M    F     M    F    M    F     M    F    M    F
 0YRS   0    0    0    0   202  202    0    0    10    9    0    0
 1YRS   0    0    0    0   191  191    0    0     1    2    6    3
 2YRS   0    0    0    0     2   48  177  131     0    3    0    0
 3YRS   0    0    0    0     2   46    0    0     1    2    0    0
 4YRS   0    0    0    0     2   44    0    0     0    2    0    0
 5YRS   0    0    0    0     2   42    0    0     1    1    0    0
 6YRS   0    0    0    0     2   41    0    0     0    2    0    0
 7YRS   0    0    0    0     2   39    0    0     0    1    1    0
 8YRS   0    0    0    0     3   38    0    0     0    2    0    0
 9YRS   0    0    0    0     3   29    0    0     0    1    0    0
10YRS   0    0    0    0     3   27    0    0     0    1    0    0
11YRS   0    0    0    0     3   27    0    0     0    1    0    0
12YRS   0    0    0    0     0    0    2   25     0    0    0    1
TOTAL   0    0    0    0   416  775  179  156    13   26    6    4
Total Population is 1231

2.                    INCOME STATEMENT

INCOME
Live Sales                  $211,827.00
Venison Sales               $233,504.27
Velvet Sales                 $51,343.74
Feeder Sales                      $0.00
Total Sales                                     $496,675.01
PLUS: End Inventory                           $1,330,409.67
LESS: Beg Inventory                           $1,423,724.52
                                              _____________
Gross Income                                    $403,360.15

EXPENSES
Feed Costs                   $40,338.56
Other Op. Costs             $102,928.83
Fixed Costs                  $65,286.00
Land Clearing                     $0.00
Depreciation                 $13,580.19
Total Expenses                                  $222,133.57
                                              _____________
EBIT                                            $181,226.58
Taxes                                            $99,115.29
                                              _____________
                                              _____________
NET INCOME                                       $82,111.29

3. CASH FLOW
Net Cash Flow                                   $174,006.34
Discounted Cash Flow                             $22,248.78
Net Present Value                               $291,600.71
```

```
YEARLY REPORT: YEAR 22
***********************
1. POPULATION STATUS
            BISON              WAPITI             MOOSE
       POP     HARVEST     POP     HARVEST     POP     HARVEST
 AGE   M   F    M    F    M    F    M    F    M    F    M    F
 0YRS  0   0    0    0  207  207    0    0   10    8    0    0
 1YRS  0   0    0    0  191  191    0    0    0    3    7    3
 2YRS  0   0    0    0    2   48  181  135    1    2    0    0
 3YRS  0   0    0    0    2   46    0    0    0    3    0    0
 4YRS  0   0    0    0    2   44    0    0    1    2    0    0
 5YRS  0   0    0    0    2   42    0    0    0    2    0    0
 6YRS  0   0    0    0    2   41    0    0    1    1    0    0
 7YRS  0   0    0    0    2   39    0    0    0    2    0    0
 8YRS  0   0    0    0    2   38    0    0    0    1    0    0
 9YRS  0   0    0    0    3   37    0    0    0    1    0    0
10YRS  0   0    0    0    3   28    0    0    0    1    0    0
11YRS  0   0    0    0    3   26    0    0    0    1    0    0
12YRS  0   0    0    0    0    0    3   26    0    0    0    1
TOTAL  0   0    0    0  419  787  184  161   12   27    7    3
Total Population is 1245

2.                  INCOME STATEMENT

INCOME
Live Sales               $197,301.29
Venison Sales            $238,916.04
Velvet Sales              $50,578.71
Feeder Sales                   $0.00
Total Sales                                  $486,796.04
PLUS: End Inventory                        $1,238,850.64
LESS: Beg Inventory                        $1,330,409.67
                                           --------------
Gross Income                                 $395,237.01

EXPENSES
Feed Costs                $43,562.49
Other Op. Costs          $103,836.24
Fixed Costs               $66,286.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                               $227,264.92
                                           --------------
EBIT                                         $167,972.09
Taxes                                         $93,691.40
                                           --------------
                                           --------------
NET INCOME                                    $74,280.69

3. CASH FLOW
Net Cash Flow                                $179,419.91
Discounted Cash Flow                          $20,800.59
Net Present Value                            $312,401.30
```

```
YEARLY REPORT: YEAR 23
************************
1. POPULATION STATUS
               BISON                WAPITI               MOOSE
          POP     HARVEST      POP    HARVEST      POP    HARVEST
 AGE      M    F    M    F    M    F    M    F    M    F    M    F
 0YRS     0    0    0    0  210  210    0    0   10    9    0    0
 1YRS     0    0    0    0  195  195    0    0    1    2    6    3
 2YRS     0    0    0    0    2   48  181  135    0    3    0    0
 3YRS     0    0    0    0    2   46    0    0    1    2    0    0
 4YRS     0    0    0    0    2   44    0    0    0    2    0    0
 5YRS     0    0    0    0    2   42    0    0    1    1    0    0
 6YRS     0    0    0    0    2   41    0    0    0    2    0    0
 7YRS     0    0    0    0    2   39    0    0    0    1    1    0
 8YRS     0    0    0    0    2   38    0    0    0    2    0    0
 9YRS     0    0    0    0    2   36    0    0    0    1    0    0
10YRS     0    0    0    0    3   35    0    0    0    1    0    0
11YRS     0    0    0    0    3   27    0    0    0    1    0    0
12YRS     0    0    0    0    0    0    2   25    0    0    0    1
TOTAL     0    0    0    0  425  802  184  160   13 [illegible] 6    4
Total Population is 1266

2.                  INCOME STATEMENT

INCOME
Live Sales               $177,593.53
Venison Sales            $238,519.79
Velvet Sales              $48,521.43
Feeder Sales                   $0.00
Total Sales                                    $464,634.75
PLUS: End Inventory                          $1,162,033.93
LESS: Beg Inventory                          $1,238,850.64
                                             -------------
Gross Income                                   $387,818.04

EXPENSES
Feed Costs                $46,498.10
Other Op. Costs          $104,813.58
Fixed Costs               $67,286.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                                 $232,177.87
                                             -------------
EBIT                                           $155,640.17
Taxes                                           $79,592.85
                                             -------------
                                             -------------
NET INCOME                                      $76,047.32

3. CASH FLOW
Net Cash Flow                                  $166,444.22
Discounted Cash Flow                            $17,495.95
Net Present Value                              $329,897.25
```

```
YEARLY REPORT: YEAR 24
***********************
1. POPULATION STATUS
            BISON           WAPITI           MOOSE
         POP   HARVEST    POP   HARVEST   POP   HARVEST
 AGE     M   F   M   F   M   F   M   F   M   F   M   F
 0YRS    0   0   0   0 214 214   0   0  10   8   0   0
 1YRS    0   0   0   0 198 198   0   0   0   3   7   3
 2YRS    0   0   0   0   2  48 185 139   1   2   0   0
 3YRS    0   0   0   0   2  46   0   0   0   3   0   0
 4YRS    0   0   0   0   2  44   0   0   1   2   0   0
 5YRS    0   0   0   0   2  42   0   0   0   2   0   0
 6YRS    0   0   0   0   2  41   0   0   1   1   0   0
 7YRS    0   0   0   0   2  39   0   0   0   2   0   0
 8YRS    0   0   0   0   2  38   0   0   0   1   0   0
 9YRS    0   0   0   0   2  36   0   0   0   1   0   0
10YRS    0   0   0   0   1  35   0   0   0   1   0   0
11YRS    0   0   0   0   3  34   0   0   0   1   0   0
12YRS    0   0   0   0   0   0   3  26   0   0   0   1
TOTAL    0   0   0   0 430 815 188 165  12  27   7   3
Total Population is 1285

2.                  INCOME STATEMENT

INCOME
Live Sales             $164,731.93
Venison Sales          $243,643.09
Velvet Sales            $47,644.50
Feeder Sales                 $0.00
Total Sales                                  $456,019.52
PLUS: End Inventory                        $1,089,205.78
LESS: Beg Inventory                        $1,162,033.93
                                        --------------
Gross Income                                 $383,191.36

EXPENSES
Feed Costs              $50,325.16
Other Op. Costs        $106,046.38
Fixed Costs             $68,286.00
Land Clearing                $0.00
Depreciation            $13,580.19
Total Expenses                               $238,237.73
                                        --------------
EBIT                                         $144,953.63
Taxes                                         $72,181.14

                                        --------------
                                        --------------
NET INCOME                                    $72,772.49

3. CASH FLOW
Net Cash Flow                                $159,180.84
Discounted Cash Flow                          $15,171.32
Net Present Value                            $345,068.58
```

```
YEARLY REPORT: YEAR 25
************************
1. POPULATION STATUS
             BISON              WAPITI             MOOSE
        POP    HARVEST     POP    HARVEST     POP    HARVEST
 AGE    M   F   M   F     M   F    M   F     M   F    M   F
 0YRS   0   0   0   0   218 218    0   0    10   9    0   0
 1YRS   0   0   0   0   202 202    0   0     1   2    6   3
 2YRS   0   0   0   0     2  48  188 142     0   3    0   0
 3YRS   0   0   0   0     2  46    0   0     1   2    0   0
 4YRS   0   0   0   0     2  44    0   0     0   2    0   0
 5YRS   0   0   0   0     2  42    0   0     1   1    0   0
 6YRS   0   0   0   0     2  41    0   0     0   2    0   0
 7YRS   0   0   0   0     2  39    0   0     0   1    1   0
 8YRS   0   0   0   0     2  38    0   0     0   2    0   0
 9YRS   0   0   0   0     2  36    0   0     0   1    0   0
10YRS   0   0   0   0     1  35    0   0     0   1    0   0
11YRS   0   0   0   0     1  33    0   0     0   1    0   0
12YRS   0   0   0   0     0   0    2  33     0   0    0   1
TOTAL   0   0   0   0   436 822  191 175    13  26    6   4
Total Population is 1298

2.                  INCOME STATEMENT

INCOME
Live Sales            $151,119.74
Venison Sales         $251,854.73
Velvet Sales           $46,278.83
Feeder Sales                $0.00
Total Sales                                 $449,253.30
PLUS: End Inventory                       $1,021,186.77
LESS: Beg Inventory                       $1,089,205.78
                                          _____________
Gross Income                                $381,234.29

EXPENSES
Feed Costs             $53,230.22
Other Op. Costs       $106,851.81
Fixed Costs            $69,286.00
Land Clearing               $0.00
Depreciation           $13,580.19
Total Expenses                              $242,948.22
                                          _____________
EBIT                                        $138,286.07
Taxes                                        $62,887.43
                                          _____________
                                          _____________
NET INCOME                                   $75,398.63

3. CASH FLOW
Net Cash Flow                               $132,997.83
Discounted Cash Flow                         $11,493.20
Net Present Value                           $356,561.78
```

```
YEARLY REPORT: YEAR 26
**************************
1. POPULATION STATUS
            BISON            WAPITI           MOOSE
        POP   HARVEST     POP   HARVEST    POP   HARVEST
 AGE    M   F   M   F   M   F   M   F   M   F   M   F
 0YRS   0   0   0   0 218 218   0   0  10   8   0   0
 1YRS   0   0   0   0 205 205   0   0   0   3   7   3
 2YRS   0   0   0   0   2  48 192 146   1   2   0   0
 3YRS   0   0   0   0   2  46   0   0   0   3   0   0
 4YRS   0   0   0   0   2  44   0   0   1   2   0   0
 5YRS   0   0   0   0   2  42   0   0   0   2   0   0
 6YRS   0   0   0   0   2  41   0   0   1   1   0   0
 7YRS   0   0   0   0   2  39   0   0   0   2   0   0
 8YRS   0   0   0   0   2  38   0   0   0   1   0   0
 9YRS   0   0   0   0   2  36   0   0   0   1   0   0
10YRS   0   0   0   0   1  35   0   0   0   1   0   0
11YRS   0   0   0   0   1  33   0   0   0   1   0   0
12YRS   0   0   0   0   0   0   1  32   0   0   0   1
TOTAL   0   0   0   0 440 826 193 178  12  27   7   3
Total Population is 1306

2.                   INCOME STATEMENT

INCOME
Live Sales                     $0.00
Venison Sales            $400,515.69
Velvet Sales              $45,485.10
Feeder Sales                   $0.00
Total Sales                                $446,000.79
PLUS: End Inventory                        $972,865.88
LESS: Beg Inventory                      $1,021,186.77
                                         ______________
Gross Income                               $397,679.91

EXPENSES
Feed Costs                $55,061.81
Other Op. Costs          $107,421.57
Fixed Costs               $70,286.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                             $246,349.56
                                         ______________
EBIT                                       $151,330.34
Taxes                                       $61,929.99
                                         ______________
                                         ______________
NET INCOME                                  $89,400.36

3. CASH FLOW
Net Cash Flow                              $151,301.44
Discounted Cash Flow                        $11,855.05
Net Present Value                          $368,416.84
```

```
YEARLY REPORT: YEAR 27
***********************
1. POPULATION STATUS
               BISON               WAPITI               MOOSE
           POP    HARVEST      POP    HARVEST      POP    HARVEST
 AGE       M    F    M    F    M    F    M    F    M    F    M    F
 0YRS      0    0    0    0  219  219    0    0   10    9    0    0
 1YRS      0    0    0    0  206  206    0    0    1    2    6    3
 2YRS      0    0    0    0    2   48  195  149    0    3    0    0
 3YRS      0    0    0    0    2   46    0    0    1    2    0    0
 4YRS      0    0    0    0    2   44    0    0    0    2    0    0
 5YRS      0    0    0    0    2   42    0    0    1    1    0    0
 6YRS      0    0    0    0    2   41    0    0    0    2    0    0
 7YRS      0    0    0    0    2   39    0    0    0    1    1    0
 8YRS      0    0    0    0    2   38    0    0    0    2    0    0
 9YRS      0    0    0    0    2   36    0    0    0    1    0    0
10YRS      0    0    0    0    1   35    0    0    0    1    0    0
11YRS      0    0    0    0    1   33    0    0    0    1    0    0
12YRS      0    0    0    0    0    0    1   32    0    0    0    1
TOTAL      0    0    0    0  442  827  196  181   13   26    6    4
Total Population is 1309

2.                   INCOME STATEMENT

INCOME
Live Sales                       $0.00
Venison Sales              $407,797.89
Velvet Sales                $44,976.32
Feeder Sales                     $0.00
Total Sales                                  $452,774.21
PLUS: End Inventory                          $933,144.71
LESS: Beg Inventory                          $972,865.88
                                          ----------------
Gross Income                                 $413,053.04

EXPENSES
Feed Costs                  $56,212.11
Other Op. Costs            $107,860.50
Fixed Costs                 $71,286.00
Land Clearing                    $0.00
Depreciation                $13,580.19
Total Expenses                               $248,938.79
                                          ----------------
EBIT                                         $164,114.25
Taxes                                         $64,809.89
                                          ----------------

                                          ----------------
NET INCOME                                    $99,304.36

3. CASH FLOW
Net Cash Flow                                $152,605.72
Discounted Cash Flow                          $10,841.64
Net Present Value                            $379,258.48
```

```
YEARLY REPORT: YEAR 28
***********************
1. POPOLATION STATUS
            BISON              WAPITI              MOOSE
         POP   HARVEST       POP   HARVEST       POP   HARVEST
 AGE     M   F   M   F   M   F   M   F   M   F   M   F
 0YRS    0   0   0   0 219 219   0   0  10   8   0   0
 1YRS    0   0   0   0 207 207   0   0   0   3   7   3
 2YRS    0   0   0   0   2  48 196 150   1   2   0   0
 3YRS    0   0   0   0   2  46   0   0   0   3   0   0
 4YRS    0   0   0   0   2  44   0   0   1   2   0   0
 5YRS    0   0   0   0   2  42   0   0   0   2   0   0
 6YRS    0   0   0   0   2  41   0   0   1   1   0   0
 7YRS    0   0   0   0   2  39   0   0   0   2   0   0
 8YRS    0   0   0   0   2  38   0   0   0   1   0   0
 9YRS    0   0   0   0   2  36   0   0   0   1   0   0
10YRS    0   0   0   0   1  35   0   0   0   1   0   0
11YRS    0   0   0   0   1  33   0   0   0   1   0   0
12YRS    0   0   0   0   0   0   1  32   0   0   0   1
TOTAL    0   0   0   0 443 828 197 182  12  27   7   3
Total Population is 1310

2.                 INCOME STATEMENT

INCOME
Live Sales                   $0.00
Venison Sales          $408,516.17
Velvet Sales            $43,979.92
Feeder Sales                 $0.00
Total Sales                                 $452,496.09
PLUS: End Inventory                         $899,845.33
LESS: Beg Inventory                         $933,144.71
                                            ___________
Gross Income                                $419,196.71

EXPENSES
Feed Costs              $56,659.01
Other Op. Costs        $108,002.06
Fixed Costs             $72,286.00
Land Clearing                $0.00
Depreciation            $13,580.19
Total Expenses                              $250,527.26
                                            ___________
EBIT                                        $168,669.44
Taxes                                        $60,789.74
                                            ___________
                                            ___________
NET INCOME                                  $107,879.70

3. CASH FLOW
Net Cash Flow                               $139,759.27
Discounted Cash Flow                          $9,002.62
Net Present Value                           $388,261.10
```

```
YEARLY REPORT: YEAR 29
************************
1. POPULATION STATUS
                BISON              WAPITI               MOOSE
        POP    HARVEST       POP    HARVEST       POP    HARVEST
AGE     M   F    M   F     M   F    M   F     M   F    M   F
 0YRS   0   0    0   0   220 220    0   0    10   9    0   0
 1YRS   0   0    0   0   207 207    0   0     1   2    6   3
 2YRS   0   0    0   0     2  48  196 150     0   3    0   0
 3YRS   0   0    0   0     2  46    0   0     1   2    0   0
 4YRS   0   0    0   0     2  44    0   0     0   2    0   0
 5YRS   0   0    0   0     2  42    0   0     1   1    0   0
 6YRS   0   0    0   0     2  41    0   0     0   2    0   0
 7YRS   0   0    0   0     2  39    0   0     0   1    1   0
 8YRS   0   0    0   0     2  38    0   0     0   2    0   0
 9YRS   0   0    0   0     2  36    0   0     0   1    0   0
10YRS   0   0    0   0     1  35    0   0     0   1    0   0
11YRS   0   0    0   0     1  33    0   0     0   1    0   0
12YRS   0   0    0   0     0   0    1  32     0   0    0   1
TOTAL   0   0    0   0   443 829  198 182    13  26    6   4
Total Population is 1311

2.                  INCOME STATEMENT

INCOME
Live Sales                     $0.00
Venison Sales            $410,738.25
Velvet Sales              $43,021.01
Feeder Sales                   $0.00
Total Sales                                   $453,759.26
PLUS: End Inventory                           $878,574.30
LESS: Beg Inventory                           $899,845.33
                                             ____________
Gross Income                                  $432,488.23

EXPENSES
Feed Costs                $56,921.60
Other Op. Costs          $108,101.12
Fixed Costs               $73,286.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                                $251,888.91
                                             ____________
EBIT                                          $180,599.32
Taxes                                          $62,923.33
                                             ____________
                                             ____________
NET INCOME                                    $117,675.99

3. CASH FLOW
Net Cash Flow                                 $152,527.21
Discounted Cash Flow                            $8,908.39
Net Present Value                             $397,169.49
```

```
YEARLY REPORT: YEAR 30
************************
1. POPULATION STATUS
                 BISON                  WAPITI                 MOOSE
          POP    HARVEST         POP    HARVEST         POP    HARVEST
 AGE      M    F    M    F    M    F    M    F    M    F    M    F
 0YRS     0    0    0    0  220  220    0    0   10    8    0    0
 1YRS     0    0    0    0  207  207    0    0    0    3    7    3
 2YRS     0    0    0    0    2   48  197  151    1    2    0    0
 3YRS     0    0    0    0    2   46    0    0    0    3    0    0
 4YRS     0    0    0    0    2   44    0    0    1    2    0    0
 5YRS     0    0    0    0    2   42    0    0    0    2    0    0
 6YRS     0    0    0    0    2   41    0    0    1    1    0    0
 7YRS     0    0    0    0    2   39    0    0    0    2    0    0
 8YRS     0    0    0    0    2   38    0    0    0    1    0    0
 9YRS     0    0    0    0    2   36    0    0    0    1    0    0
10YRS     0    0    0    0    1   35    0    0    0    1    0    0
11YRS     0    0    0    0    1   33    0    0    0    1    0    0
12YRS     0    0    0    0    0    0    1   32    0    0    0    1
TOTAL     0    0    0    0  443  829  198  182   12   27    7    3
Total Population is 1311

2.                   INCOME STATEMENT

INCOME
Live Sales                       $0.00
Venison Sales              $410,399.27
Velvet Sales                $41,974.13
Feeder Sales                     $0.00
Total Sales                                         $452,373.40
PLUS: End Inventory                                 $867,300.34
LESS: Beg Inventory                                 $878,574.30
                                                   ____________
Gross Income                                        $441,099.44

EXPENSES
Feed Costs                  $57,034.95
Other Op. Costs            $108,105.66
Fixed Costs                 $74,286.00
Land Clearing                    $0.00
Depreciation                $13,580.19
Total Expenses                                      $253,006.80
                                                   ____________
EBIT                                                $188,092.64
Taxes                                                $38,134.23
                                                   ____________
                                                   ____________
NET INCOME                                          $149,958.41

3. CASH FLOW
Net Cash Flow                                       -$26,240.45
Discounted Cash Flow                                 -$1,389.59
Net Present Value                                   $395,779.90
```

```
YEARLY REPORT: YEAR 31
************************
1. POPULATION STATUS
              BISON                WAPITI                MOOSE
        POP    HARVEST        POP    HARVEST        POP    HARVEST
AGE     M   F   M   F       M   F    M    F        M   F    M   F
 0YRS   0   0   0   0     220 220    0    0       10   9    0   0
 1YRS   0   0   0   0     207 207    0    0        1   2    6   3
 2YRS   0   0   0   0       2  48  197  151        0   3    0   0
 3YRS   0   0   0   0       2  46    0    0        1   2    0   0
 4YRS   0   0   0   0       2  44    0    0        0   2    0   0
 5YRS   0   0   0   0       2  42    0    0        1   1    0   0
 6YRS   0   0   0   0       2  41    0    0        0   2    0   0
 7YRS   0   0   0   0       2  39    0    0        0   1    1   0
 8YRS   0   0   0   0       2  38    0    0        0   2    0   0
 9YRS   0   0   0   0       2  36    0    0        0   1    0   0
10YRS   0   0   0   0       1  35    0    0        0   1    0   0
11YRS   0   0   0   0       1  33    0    0        0   1    0   0
12YRS   0   0   0   0       0   0    1   32        0   0    0   1
TOTAL   0   0   0   0     443 829  198  183       13  26    6   4
Total Population is 1312

2.                    INCOME STATEMENT

INCOME
Live Sales                        $0.00
Venison Sales               $411,430.33
Velvet Sales                 $40,956.23
Feeder Sales                      $0.00
Total Sales                                        $452,386.57
PLUS: End Inventory                                $857,321.37
LESS: Beg Inventory                                $867,300.34
                                                 ______________
Gross Income                                       $442,407.60

EXPENSES
Feed Costs                   $57,088.60
Other Op. Costs             $108,125.67
Fixed Costs                  $75,286.00
Land Clearing                     $0.00
Depreciation                 $13,580.19
Total Expenses                                     $254,080.46
                                                 ______________
EBIT                                               $188,327.14
Taxes                                               $56,264.39
                                                 ______________
                                                 ______________
NET INCOME                                         $132,062.75

3. CASH FLOW
Net Cash Flow                                      $155,621.91
Discounted Cash Flow                                 $7,472.23
Net Present Value                                  $403,252.13
```

```
YEARLY REPORT: YEAR 32
************************
1. POPULATION STATUS
              BISON                WAPITI               MOOSE
          POP    HARVEST       POP    HARVEST       POP    HARVEST
 AGE      M   F   M   F     M   F   M   F      M   F   M   F
 0YRS     0   0   0   0   220 220   0   0     10   8   0   0
 1YRS     0   0   0   0   207 207   0   0      0   3   7   3
 2YRS     0   0   0   0     2  48 197 151      1   2   0   0
 3YRS     0   0   0   0     2  46   0   0      0   3   0   0
 4YRS     0   0   0   0     2  44   0   0      1   2   0   0
 5YRS     0   0   0   0     2  42   0   0      0   2   0   0
 6YRS     0   0   0   0     2  41   0   0      1   1   0   0
 7YRS     0   0   0   0     2  39   0   0      0   2   0   0
 8YRS     0   0   0   0     2  38   0   0      0   1   0   0
 9YRS     0   0   0   0     2  36   0   0      0   1   0   0
10YRS     0   0   0   0     1  35   0   0      0   1   0   0
11YRS     0   0   0   0     1  33   0   0      0   1   0   0
12YRS     0   0   0   0     0   0   1  32      0   0   0   1
TOTAL     0   0   0   0   444 829 198 183     12  27   7   3
Total Population is 1312

2.                  INCOME STATEMENT

INCOME
Live Sales                    $0.00
Venison Sales           $410,842.50
Velvet Sales             $39,938.73
Feeder Sales                  $0.00
Total Sales                                      $450,781.23
PLUS: End Inventory                              $851,193.98
LESS: Beg Inventory                              $857,321.37
                                               _____________
Gross Income                                     $444,653.84

EXPENSES
Feed Costs               $57,123.44
Other Op. Costs         $108,098.78
Fixed Costs              $76,286.00
Land Clearing                 $0.00
Depreciation             $13,580.19
Total Expenses                                   $255,088.41
                                               _____________
EBIT                                             $189,565.43
Taxes                                             $56,437.29
                                               _____________
                                               _____________
NET INCOME                                       $133,128.14

3. CASH FLOW
Net Cash Flow                                    $152,835.72
Discounted Cash Flow                               $6,653.78
Net Present Value                                $409,905.92
```

```
YEARLY REPORT: YEAR 33
************************
1. POPULATION STATUS
              BISON                 WAPITI               MOOSE
          POP    HARVEST       POP    HARVEST      POP    HARVEST
 AGE      M   F   M   F      M   F    M    F      M   F    M   F
 0YRS     0   0   0   0    220 220    0    0     10   9    0   0
 1YRS     0   0   0   0    207 207    0    0      1   2    6   3
 2YRS     0   0   0   0      2  48  197  151      0   3    0   0
 3YRS     0   0   0   0      2  46    0    0      1   2    0   0
 4YRS     0   0   0   0      2  44    0    0      0   2    0   0
 5YRS     0   0   0   0      2  42    0    0      1   1    0   0
 6YRS     0   0   0   0      2  41    0    0      0   2    0   0
 7YRS     0   0   0   0      2  39    0    0      0   1    1   0
 8YRS     0   0   0   0      2  38    0    0      0   2    0   0
 9YRS     0   0   0   0      2  36    0    0      0   1    0   0
10YRS     0   0   0   0      1  35    0    0      0   1    0   0
11YRS     0   0   0   0      1  33    0    0      0   1    0   0
12YRS     0   0   0   0      0   0    1   32      0   0    0   1
TOTAL     0   0   0   0    444 829  198  183     13  26    6   4
Total Population is 1312

2.                  INCOME STATEMENT

INCOME
Live Sales                     $0.00
Venison Sales            $411,593.23
Velvet Sales              $38,947.31
Feeder Sales                   $0.00
Total Sales                                  $450,540.54
PLUS: End Inventory                          $851,250.56
LESS: Beg Inventory                          $851,193.98
                                             -----------
Gross Income                                 $450,597.12

EXPENSES
Feed Costs                $57,127.90
Other Op. Costs          $108,100.99
Fixed Costs               $77,[illegible]86.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                               $256,095.08
                                             -----------
EBIT                                         $194,502.04
Taxes                                         $56,648.75
                                             -----------
                                             -----------
NET INCOME                                   $137,853.29

3. CASH FLOW
Net Cash Flow                                $151,376.89
Discounted Cash Flow                           $5,975.40
Net Present Value                            $415,881.32
```

```
YEARLY REPORT: YEAR 34
************************
1. POPULATION STATUS
              BISON                WAPITI              MOOSE
          POP      HARVEST      POP    HARVEST     POP    HARVEST
 AGE     M    F    M    F    M    F    M    F    M    F    M    F
 0YRS    0    0    0    0  220  220    0    0   10    8    0    0
 1YRS    0    0    0    0  207  207    0    0    0    3    7    3
 2YRS    0    0    0    0    2   48  197  151    1    2    0    0
 3YRS    0    0    0    0    2   46    0    0    0    3    0    0
 4YRS    0    0    0    0    2   44    0    0    1    2    0    0
 5YRS    0    0    0    0    2   42    0    0    0    2    0    0
 6YRS    0    0    0    0    2   41    0    0    1    1    0    0
 7YRS    0    0    0    0    2   39    0    0    0    2    0    0
 8YRS    0    0    0    0    2   38    0    0    0    1    0    0
 9YRS    0    0    0    0    2   36    0    0    0    1    0    0
10YRS    0    0    0    0    1   35    0    0    0    1    0    0
11YRS    0    0    0    0    1   33    0    0    0    1    0    0
12YRS    0    0    0    0    0    0    1   32    0    0    0    1
TOTAL    0    0    0    0  444  829  198  183   12   27    7    3
Total Population is 1312

2.                  INCOME STATEMENT

INCOME
Live Sales                      $0.00
Venison Sales             $410,946.82
Velvet Sales               $37,975.06
Feeder Sales                    $0.00
Total Sales                                       $448,921.88
PLUS: End Inventory                               $851,234.71
LESS: Beg Inventory                               $851,250.56
                                                 _____________
Gross Income                                      $448,906.03

EXPENSES
Feed Costs                 $57,144.26
Other Op. Costs           $108,067.47
Fixed Costs                $78,286.00
Land Clearing                   $0.00
Depreciation               $13,580.19
Total Expenses                                    $257,077.93
                                                 _____________
EBIT                                              $191,828.10
Taxes                                              $56,361.39
                                                 _____________
                                                 _____________
NET INCOME                                        $135,466.71

3. CASH FLOW
Net Cash Flow                                     $149,062.75
Discounted Cash Flow                                $5,335.07
Net Present Value                                 $421,216.39
```

```
YEARLY REPORT: YEAR 35
************************
1. POPULATION STATUS
               BISON              WAPITI             MOOSE
         POP     HARVEST      POP    HARVEST     POP    HARVEST
 AGE     M   F   M    F     M    F   M    F     M   F   M    F
 0YRS    0   0   0    0   220  220   0    0    10   9   0    0
 1YRS    0   0   0    0   207  207   0    0     1   2   6    3
 2YRS    0   0   0    0     2   48 197  151     0   3   0    0
 3YRS    0   0   0    0     2   46   0    0     1   2   0    0
 4YRS    0   0   0    0     2   44   0    0     0   2   0    0
 5YRS    0   0   0    0     2   42   0    0     1   1   0    0
 6YRS    0   0   0    0     2   41   0    0     0   2   0    0
 7YRS    0   0   0    0     2   39   0    0     0   1   1    0
 8YRS    0   0   0    0     2   38   0    0     0   2   0    0
 9YRS    0   0   0    0     2   36   0    0     0   1   0    0
10YRS    0   0   0    0     1   35   0    0     0   1   0    0
11YRS    0   0   0    0     1   33   0    0     0   1   0    0
12YRS    0   0   0    0     0    0   1   32     0   0   0    1
TOTAL    0   0   0    0   444  829 198  183    13  26   6    4
Total Population is 1312

2.                  INCOME STATEMENT

INCOME
Live Sales                       $0.00
Venison Sales              $411,631.57
Velvet Sales                $37,027.25
Feeder Sales                     $0.00
Total Sales                                    $448,658.83
PLUS: End Inventory                            $851,273.91
LESS: Beg Inventory                            $851,234.71
                                              ____________
Gross Income                                   $448,698.03

EXPENSES
Feed Costs                  $57,137.15
Other Op. Costs            $108,066.23
Fixed Costs                 $79,286.00
Land Clearing                    $0.00
Depreciation                $13,580.19
Total Expenses                                 $258,069.58
                                              ____________
EBIT                                           $190,628.45
Taxes                                           $54,714.61
                                              ____________
                                              ____________
NET INCOME                                     $135,913.84

3. CASH FLOW
Net Cash Flow                                  $134,454.83
Discounted Cash Flow                             $4,363.27
Net Present Value                              $425,579.66
```

```
YEARLY REPORT: YEAR 36
************************
1. POPULATION STATUS
              BISON                  WAPITI                MOOSE
         POP     HARVEST        POP      HARVEST       POP      HARVEST
AGE      M   F   M   F      M    F    M    F       M    F    M    F
 0YRS    0   0   0   0    220  220    0    0      10    8    0    0
 1YRS    0   0   0   0    207  207    0    0       0    3    7    3
 2YRS    0   0   0   0      2   48  197  151       1    2    0    0
 3YRS    0   0   0   0      2   46    0    0       0    3    0    0
 4YRS    0   0   0   0      2   44    0    0       1    2    0    0
 5YRS    0   0   0   0      2   42    0    0       0    2    0    0
 6YRS    0   0   0   0      2   41    0    0       1    1    0    0
 7YRS    0   0   0   0      2   39    0    0       0    2    0    0
 8YRS    0   0   0   0      2   38    0    0       0    1    0    0
 9YRS    0   0   0   0      2   36    0    0       0    1    0    0
10YRS    0   0   0   0      1   35    0    0       0    1    0    0
11YRS    0   0   0   0      1   33    0    0       0    1    0    0
12YRS    0   0   0   0      0    0    1   32       0    0    0    1
TOTAL    0   0   0   0    444  829  198  183      12   27    7    3
Total Population is 1312

2.                    INCOME STATEMENT

INCOME
Live Sales                        $0.00
Venison Sales               $410,971.38
Velvet Sales                 $36,101.89
Feeder Sales                      $0.00
Total Sales                                        $447,073.27
PLUS: End Inventory                                $851,244.30
LESS: Beg Inventory                                $851,273.91
                                                  ______________
Gross Income                                       $447,043.66

EXPENSES
Feed Costs                   $57,149.17
Other Op. Costs             $108,031.88
Fixed Costs                  $80,286.00
Land Clearing                     $0.00
Depreciation                 $13,580.19
Total Expenses                                     $259,047.24
                                                  ______________
EBIT                                               $187,996.42
Taxes                                               $55,960.04
                                                  ______________
                                                  ______________
NET INCOME                                         $132,036.38

3. CASH FLOW
Net Cash Flow                                      $145,646.18
Discounted Cash Flow                                 $4,285.47
Net Present Value                                  $429,865.12
```

```
YEARLY REPORT: YEAR 37
***********************
1. POPULATION STATUS
                 BISON                WAPITI              MOOSE
         POP     HARVEST       POP     HARVEST      POP     HARVEST
AGE     M   F    M   F       M   F    M   F       M   F    M   F
 0YRS   0   0    0   0     220 220    0   0      10   9    0   0
 1YRS   0   0    0   0     207 207    0   0       1   2    6   3
 2YRS   0   0    0   0       2  48  197 151       0   3    0   0
 3YRS   0   0    0   0       2  46    0   0       1   2    0   0
 4YRS   0   0    0   0       2  44    0   0       0   2    0   0
 5YRS   0   0    0   0       2  42    0   0       1   1    0   0
 6YRS   0   0    0   0       2  41    0   0       0   2    0   0
 7YRS   0   0    0   0       2  39    0   0       0   1    1   0
 8YRS   0   0    0   0       2  38    0   0       0   2    0   0
 9YRS   0   0    0   0       2  36    0   0       0   1    0   0
10YRS   0   0    0   0       1  35    0   0       0   1    0   0
11YRS   0   0    0   0       1  33    0   0       0   1    0   0
12YRS   0   0    0   0       0   0    1  32       0   0    0   1
TOTAL   0   0    0   0     444 829  198 183      13  26    6   4
Total Population is 1312

2.                   INCOME STATEMENT

INCOME
Live Sales                       $0.00
Venison Sales              $411,640.60
Velvet Sales                $35,199.70
Feeder Sales                     $0.00
Total Sales                                        $446,840.30
PLUS: End Inventory                                $851,279.41
LESS: Beg Inventory                                $851,244.30
                                                  -------------
Gross Income                                       $446,875.40

EXPENSES
Feed Costs                  $57,139.33
Other Op. Costs            $108,030.54
Fixed Costs                 $81,286.00
Land Clearing                    $0.00
Depreciation                $13,580.19
Total Expenses                                     $260,036.06
                                                  -------------
EBIT                                               $186,839.34
Taxes                                               $55,876.92
                                                  -------------
                                                  -------------
NET INCOME                                         $130,962.42

3. CASH FLOW
Net Cash Flow                                      $144,507.50
Discounted Cash Flow                                 $3,855.26
Net Present Value                                  $433,720.38
```

```
YEARLY REPORT: YEAR 38
***********************
1. POPULATION STATUS
            BISON              WAPITI              MOOSE
         POP    HARVEST     POP    HARVEST     POP    HARVEST
 AGE     M   F   M   F     M   F    M   F     M   F   M   F
 0YRS    0   0   0   0   220 220    0   0    10   8   0   0
 1YRS    0   0   0   0   207 207    0   0     0   3   7   3
 2YRS    0   0   0   0     2  48  197 151     1   2   0   0
 3YRS    0   0   0   0     2  46    0   0     0   3   0   0
 4YRS    0   0   0   0     2  44    0   0     1   2   0   0
 5YRS    0   0   0   0     2  42    0   0     0   2   0   0
 6YRS    0   0   0   0     2  41    0   0     1   1   0   0
 7YRS    0   0   0   0     2  39    0   0     0   2   0   0
 8YRS    0   0   0   0     2  38    0   0     0   1   0   0
 9YRS    0   0   0   0     2  36    0   0     0   1   0   0
10YRS    0   0   0   0     1  35    0   0     0   1   0   0
11YRS    0   0   0   0     1  33    0   0     0   1   0   0
12YRS    0   0   0   0     0   0    1  32     0   0   0   1
TOTAL    0   0   0   0   444 829  198 183    12  27   7   3
Total Population is 1312

2.                  INCOME STATEMENT

INCOME
Live Sales                     $0.00
Venison Sales            $410,977.16
Velvet Sales              $34,913.46
Feeder Sales                   $0.00
Total Sales                                   $445,890.62
PLUS: End Inventory                           $851,246.55
LESS: Beg Inventory                           $851,279.41
                                              ___________
Gross Income                                  $445,857.76

EXPENSES
Feed Costs                $57,150.32
Other Op. Costs          $108,008.55
Fixed Costs               $82,286.00
Land Clearing                  $0.00
Depreciation              $13,580.19
Total Expenses                                $261,025.06
                                              ___________
EBIT                                          $184,832.70
Taxes                                          $55,547.43
                                              ___________
                                              ___________
NET INCOME                                    $129,285.27

3. CASH FLOW
Net Cash Flow                                 $142,898.31
Discounted Cash Flow                            $3,456.64
Net Present Value                             $437,177.02
```

```
YEARLY REPORT: YEAR 39
************************
1. POPULATION STATUS
              BISON               WAPITI              MOOSE
         POP     HARVEST      POP    HARVEST     POP    HARVEST
 AGE     M   F    M    F    M   F    M    F     M   F    M   F
 0YRS    0   0    0    0  220 220    0    0    10   9    0   0
 1YRS    0   0    0    0  207 207    0    0     1   2    6   3
 2YRS    0   0    0    0    2  48  197  151     0   3    0   0
 3YRS    0   0    0    0    2  46    0    0     1   2    0   0
 4YRS    0   0    0    0    2  44    0    0     0   2    0   0
 5YRS    0   0    0    0    2  42    0    0     1   1    0   0
 6YRS    0   0    0    0    2  41    0    0     0   2    0   0
 7YRS    0   0    0    0    2  39    0    0     0   1    1   0
 8YRS    0   0    0    0    2  38    0    0     0   2    0   0
 9YRS    0   0    0    0    2  36    0    0     0   1    0   0
10YRS    0   0    0    0    1  35    0    0     0   1    0   0
11YRS    0   0    0    0    1  33    0    0     0   1    0   0
12YRS    0   0    0    0    0   0    1   32     0   0    0   1
TOTAL    0   0    0    0  444 829  198  183    13  26    6   4
Total Population is 1312

2.                  INCOME STATEMENT

INCOME
Live Sales                      $0.00
Venison Sales             $411,642.72
Velvet Sales               $34,913.54
Feeder Sales                    $0.00
Total Sales                                   $446,556.26
PLUS: End Inventory                           $851,280.70
LESS: Beg Inventory                           $851,246.55
                                             ______________
Gross Income                                  $446,590.41

EXPENSES
Feed Costs                 $57,139.84
Other Op. Costs           $108,025.02
Fixed Costs                $83,286.00
Land Clearing                   $0.00
Depreciation               $13,580.19
Total Expenses                                $262,031.06
                                             ______________
EBIT                                          $184,559.35
Taxes                                          $55,647.98
                                             ______________
                                             ______________
NET INCOME                                    $128,911.37

3. CASH FLOW
Net Cash Flow                                 $142,457.42
Discounted Cash Flow                            $3,124.47
Net Present Value                             $440,301.48
```

```
YEARLY REPORT: YEAR 40
************************
1. POPULATION STATUS
              BISON              WAPITI              MOOSE
         POP    HARVEST       POP    HARVEST      POP    HARVEST
 AGE     M   F    M   F     M   F    M   F      M   F    M   F
 0YRS    0   0    0   0   220 220    0   0     10   8    0   0
 1YRS    0   0    0   0   207 207    0   0      0   3    7   3
 2YRS    0   0    0   0     2  48  197 151      1   2    0   0
 3YRS    0   0    0   0     2  46    0   0      0   3    0   0
 4YRS    0   0    0   0     2  44    0   0      1   2    0   0
 5YRS    0   0    0   0     2  42    0   0      0   2    0   0
 6YRS    0   0    0   0     2  41    0   0      1   1    0   0
 7YRS    0   0    0   0     2  39    0   0      0   2    0   0
 8YRS    0   0    0   0     2  38    0   0      0   1    0   0
 9YRS    0   0    0   0     2  36    0   0      0   1    0   0
10YRS    0   0    0   0     1  35    0   0      0   1    0   0
11YRS    0   0    0   0     1  33    0   0      0   1    0   0
12YRS    0   0    0   0     0   0    1  32      0   0    0   1
TOTAL    0   0    0   0   444 829  198 183     12  27    7   3
Total Population is 1312

2.                    INCOME STATEMENT

INCOME
Live Sales                      $0.00
Venison Sales             $410,978.52
Velvet Sales               $34,913.56
Feeder Sales                    $0.00
Total Sales                                     $445,892.08
PLUS: End Inventory                             $851,247.09
LESS: Beg Inventory                             $851,280.70
                                               ------------
Gross Income                                    $445,858.46

EXPENSES
Feed Costs                 $57,150.59
Other Op. Costs           $108,008.66
Fixed Costs                $84,286.00
Land Clearing                   $0.00
Depreciation               $13,580.19
Total Expenses                                  $263,025.44
                                               ------------
EBIT                                            $182,833.02
Taxes                                            $51,052.81

                                               ------------
                                               ------------
NET INCOME                                      $131,780.21

3. CASH FLOW
Net Cash Flow                                   $117,324.01
Discounted Cash Flow                              $2,333.14
Net Present Value                               $442,634.63
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KIKINO GAME RANCH SIMULATION
SUMMARY REPORT FOR 40 YEARS OPERATION

1. Cash Flows
          YEAR          PV of CashFlow   Net Present Value
             0         -$1,700,153.50      -$1,700,153.50
             1             $37,661.23      -$1,662,492.27
             2             $34,915.16      -$1,627,577.11
             3             $42,447.51      -$1,585,129.59
             4            $135,342.31      -$1,449,787.29
             5            $148,638.47      -$1,301,148.81
             6            $154,904.44      -$1,146,244.37
             7            $161,344.96        -$984,899.41
             8            $169,639.92        -$815,259.49
             9            $162,626.88        -$652,632.61
            10            $152,390.05        -$500,242.56
            11            $146,844.90        -$353,397.67
            12            $101,455.53        -$251,942.14
            13            $106,552.94        -$145,389.20
            14             $86,050.91         -$59,338.29
            15             $73,010.28          $13,671.99
            16             $96,870.81         $110,342.80
            17             $38,478.52         $148,821.32
            18             $59,020.81         $207,842.13
            19             $34,542.12         $242,384.26
            20             $26,967.68         $269,351.93
            21             $22,248.78         $291,600.71
            22             $20,800.59         $312,401.30
            23             $17,495.95         $329,897.25
            24             $15,171.32         $345,068.58
            25             $11,493.20         $356,561.78
            26             $11,855.05         $368,416.84
            27             $10,841.64         $379,258.48
            28              $9,002.62         $388,261.10
            29              $8,908.39         $397,169.49
            30             -$1,389.59         $395,779.90
            31              $7,472.23         $403,252.13
            32              $6,653.78         $409,905.92
            33              $5,975.40         $415,881.32
            34              $5,335.07         $421,216.39
            35              $4,363.27         $425,579.66
            36              $4,285.47         $429,865.12
            37              $3,855.26         $433,720.38
            38              $3,456.64         $437,177.02
            39              $3,124.47         $440,301.48
            40              $2,333.14         $442,634.63

 2. Market value in year 40 is $1,269,146.05
   (Assume ranch earns average of last 5 years
    net income in perpetuity.)

    Ranch Net Present Value is   $467,873.28
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